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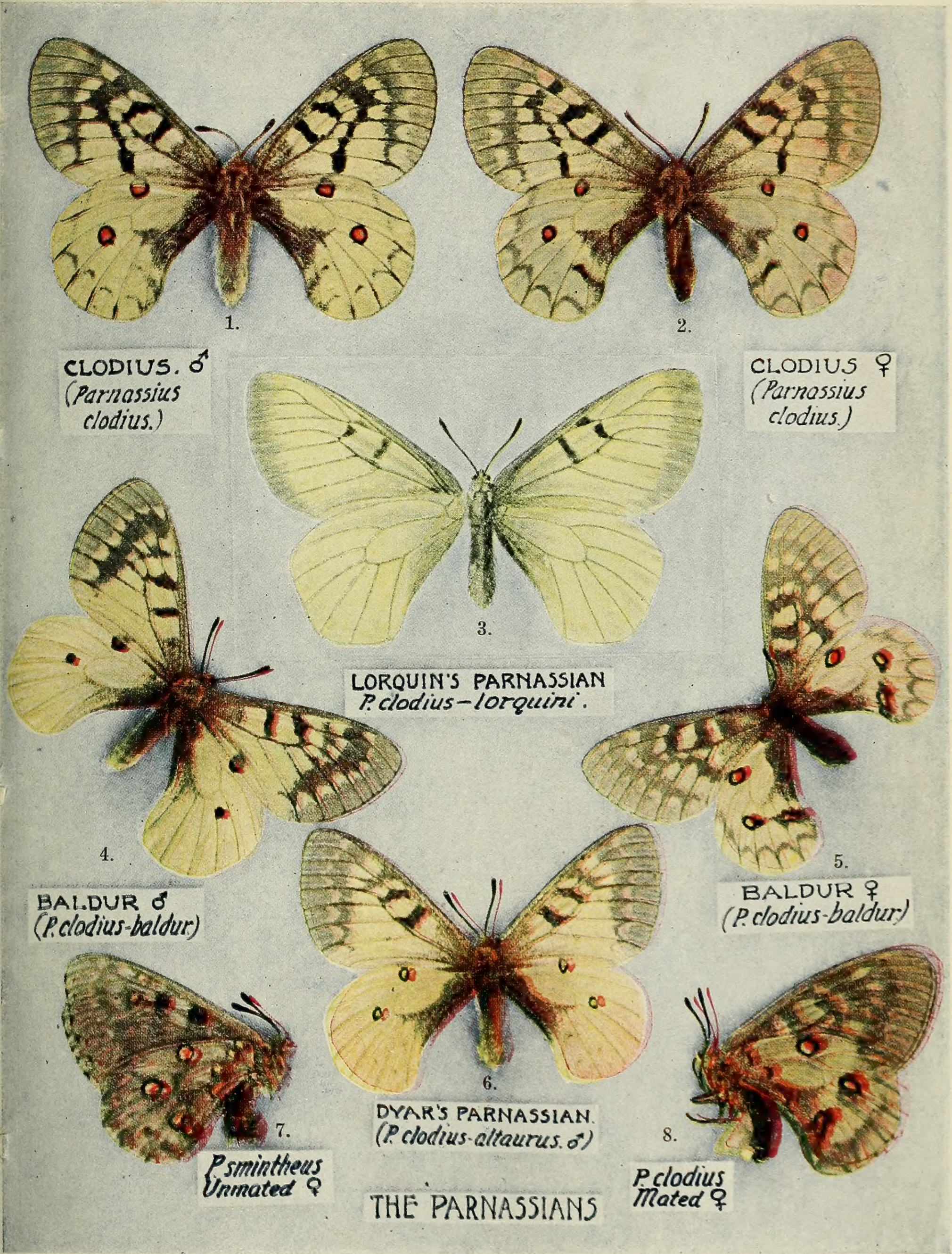
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NEW PLANTS FROM S. CALIFORNIA

A. DAVIDSON, M. D.

ASTER STANDLEYI n. sp.

Suffruticose, 3-6 dm. high; bark white; herbage glabrous throughout; leaves ovate-lanceolate, 2-3 cm. long with 2 or 3 triangular teeth on each side, apex acute, upper leaves sessile by a narrow base; flower heads solitary, terminal, 3 cm. broad; bracts in 2 rows, outer bracts green, linear-lanceolate, 1 mm. broad, 15 mm. long, inner bracts paler twice as broad, margins hyaline and slightly lacerate with a few microscopic stalked glands along the edges; rays 2½ cm. long, light lavender; achenes (immature) very broad and very villous; pappus of numerous dull white bristles.

Type No. 3487, Painted Canyon, Mecca, Colorado Desert. Collected by Mr. F. Fultz, March, 1922.

This plant stands between **A. tortifolius** Gray and **A. Orcuttii** Vas. & Rose. Apart from the bracts it differs from the former in the shape of the leaf and in being glabrous throughout. In the latter the leaves are glabrous but larger, sessile by a broad base and closely spinulose. It is named in honor of Mr. Paul C. Standley to whom I am personally indebted for invaluable aid in the identification of California plants.

DUDLEYA PARVA Rose & Davidson. n. sp.

Acaulescent, with 8-10 basal leaves; leaves fleshy, 5-7 cm. long, ovate-lanceolate to oblong-linear, 2.5-6 cm. long, convex beneath, concave above, acute; inflorescence of 2-4 ascending racemes, somewhat paniculate, in cultivation weak, soon prostrate; leaves on flowering branches several, linear, spreading at right angles to the rachis, 1-2 cm. long; flower bud somewhat angled, pointed; sepals 3-5, nearly equal, green, acutish; corolla about 10 mm. long, greenish yellow, with a very short tube; petals acute.

Collected by Mrs. J. H. Bullard on a clay bank on the Conejo Grade, Southern California, May, 1922. (No. 3535 Type.)

In general appearance this plant looks like a Hasseanthus. The basal leaves are arranged in two loose whorls very unlike the close rosettes in our common Dudleyas. The plant has been successfully cultivated by Dr. J. N. Rose in Washington and by Mr. Robert Kessler in Los Angeles.

Aster' Standleyi

SOUTHERN CALIFORNIA PLANT NOTES—I.

PHILIP A. MUNZ

There is presented herein information on various species of Southern California plants, giving largely distributional notes and ecological data. It supplements material given in Dr. Jepson's Flora of California (Parts 1-7, 1909-1922) and lists plants omitted from the papers on the San Jacinto Mts. (Hall, Univ. Cal. Pub. Bot. 1:1-140, 1902), San Bernardino Mts. (Parish, Pl. World 20:163-178, 208-223, 245-259, 1917), and San Antonio Mts. (Johnston, Pl. World 22:71-90 & 105-122, 1919).

Carex Hoodii Boott. in Hook. Fl. Bor. Am. 2:211. 1840.

The first collection to be reported from Southern California is from Tahquitz Valley, San Jacinto Mts. (**Munz 6005**), where it is common at the edge of a meadow at 7,200 feet alt. Det. by Mackenzie.

Carex illota Bailey. Mem. Torr. Club 1:15. 1889.

Collected in Bear Valley of the San Bernardino Mts., where it is frequent at 7,500 ft. alt. in wet meadows two miles east of Bluff Lake (**Munz 5636**). According to Mackenzie this is the first Southern California record for this species "unless some of the Parish material really belonged here. What I have seen did not."

Carex Hassei Bailey. Bot. Gaz. 21:5. 1896.

Previously known only as far south as the San Bernardino Mts., but occurs in the Santa Rosa Mts. at the abandoned Indian village of Santa Rosa, where it is occasional on moist banks of the creek at 6,600 ft. alt. (**Munz 5862**). Det. by Mackenzie.

Veratrum californicum Durand. Jour. Acad. Phila. (2) 3:103. 1855.

Abundant in wet places on the north slope of the San Antonio Mts., as in Swartout Valley (**Munz 4639**) and Mescal Creek (**Munz 5578**).

Microstylis monophyllos (L.) Lindl. Bot. Reg. pl. 1290. 1829.

The first report of this plant from California was by Munz and Johnston (Bull. Torrey Club 49:349. 1922) and was based on a collection by F. W. Peirson in the San Bernardino Mts., where it is well distributed on the south fork of the Santa Ana River from 7,500 to 8,700 ft. alt., growing on small hummocks in wet meadows (**Munz 6165 & 6188**). It can be reported from similar situations in "Skunk-cabbage Meadow" in Tahquitz Valley, San Jacinto Mts. (**Munz 6366**).

Spiranthes Romanzoffiana C. & S. Linnaea 3:32. 1828.

This orchid occurs sparingly in the San Jacinto Mts., growing in wet places in "Skunk-cabbage Meadow," Tahquitz Valley, at 7,200 ft. alt. (**Munz 6365**) and at 9,000 ft. in Round Valley (**Munz 6392**).

Celtis Douglasii Plan. Ann. Sc. Nat. (3) 10:293. 1848.

The previously recorded stations are: Independence in Inyo County, Hackberry Canyon in Kern County, and Campo in San Diego County (Parish, Bull. So. Cal. Acad. 20:31. 1921). An additional station for it is near Banning (**Jaeger**, April, 1920 & **Mary F. Spencer**, 1804) where a few trees grow in a small, well watered canyon known as Gilman's Water Canyon, and attain a height of about 30 feet.

Eriogonum fasciculatum var. **flavoviride** Munz & Johnston. Bull. Torrey Club 49:350. 1922.

The variety is common on rocky slopes and along washes in the mountain ranges extending eastward from the San Bernardino Mts. It is associated commonly with the var. **polifolium** T. & G., but is very distinct from the latter when growing, because of the yellowish-green, glabrate leaves and twigs. The following collections additional to those named in the original description may be cited: Anshutz Canyon, Eagle Mts. (**Munz & Keck 4949**), Coyote Holes, Little San Bernardino Mts. (**Munz & Johnston 5206**), and Quail Springs in the same range (**Munz & Johnston 5231**).

Monolepis spathulata Gray. Proc. Am. Acad. 7:389. 1868.

I have found no reference to this species in literature on Southern California, but numerous collections have been made in the San Bernardino Mts., where it grows on wet sandy banks and shores: Santa Ana River at 7,100 ft. alt. (**Peirson 3148**), Cienega Seca Creek (**Munz 6289**), Bear Valley (**S. B. & W. F. Parish 1518** and **Abrams 2088**, and **J. B. Feudge**, July, 1922).

Sagina Linnaei Presl. Rel. Haenk. 2:14. 1835.

To be added to the list of species occurring in the San Antonio Mts., having been found by F. W. and Mabel Peirson and the writer at Kelly's Cabin northeast of Ontario Peak (**Munz 6081**).

Euphorbia misera Benth. Bot. Sulph. 51. 1844.

This small shrub apparently has a wider range than that assigned to it by Abrams (Bull. N. Y. Bot. Gard. 6:400. 1910), i. e., along the coast from San Diego southward and on the islands. It grows on dry bluffs at Arch Beach, just south of Laguna Beach (**Peirson 2041** &

Munz 6359) and has been found in the desert region at Palm Springs (**Jaeger 52**) growing at Whitewater Bench.

Cassia Covesii Gray. Proc. Am. Acad. 7:399. 1868.

Cited in Bot. Calif. (1:161. 1880) from the "Big Canyon of the Tantillas Mts., below San Diego," and by Pollard (Bull. Torrey Club 21:212. 1894) from "Southern California," but has been seldom collected in our area. It grows in sandy washes and can be reported from several localities on the Colorado Desert: Vallecito (**S. B. & W. F. Parish 1409**), San Gregorio (**Brandegee, Dudley Herb**), Martinez Canyon, Santa Rosa Mts. (**Jaeger, Baker Herb**), and Chuckwalla Mts. (**Munz & Keck 4862**). The last named station was found by M. French Gilman.

Acer Negundo var. **californicum** (T. & G.) Sarg. Gard. & For. 4:148. 1891.

The San Bernardino Mts. are generally given as the southern limit for our native box-elder, but it is occasional along the banks of the upper part of Pipe Creek in the southern part of the San Jacinto Mts. (**Munz 5804**).

Elatine californica Gray. Proc. Am. Acad. 13:364. 1878.

Rather widespread in Southern California in the mud flats left by the drying of winter pools: Laguna Canyon, Orange County (Johnston, Bull. So. Cal. Acad. 17:65. 1918), north of Laguna Beach (**Munz 4478**), Menifee Valley, Riverside County (**Munz & Johnston 5569**), Hemet Valley, San Jacinto Mts. (**Munz & Johnston 5460 & 5520**), Mystic Lake near Moreno (**Munz & Johnston 5546**), and Red Hill near Upland (**Munz 5557**).

Viola Macloskeyi Lloyd. Erythea 3:74. 1895.

Growing with *Sagina Linnaei* Presl. in the San Antonio Mts. (**Munz 6082**).

Petalonyx linearis Greene. Bull. Cal. Acad. (1) 4:188. 1885.

Several collections of this species have been made in the canyons of the Colorado Desert: Rockhouse Canyon (**Jaeger 1197**), Deep Canyon (**Peirson 2376**), and Thousand Palms Canyon (**Jaeger 1198**). Not previously recorded from the state. Mr. Jaeger writes that it is nowhere abundant.

Cornus glabrata Benth. Bot. Voy. Sulph. 18. 1844.

Known from several Southern California collections: Santa Barbara County between Santa Ynez Mission and Gaviota Pass (**Abrams 6527**), Mt. Pinos Region (**Dudley & Lamb 4652**), Pipe Creek in San

Jacinto Mts. (**Munz 5806**), and Warners Hot Springs (**Mrs. Buttle**, Cal. Acad. Herb.). Along the banks of Pipe Creek it is an abundant shrub for perhaps a mile, growing to a height of fifteen feet. There its erect habit and gray twigs and branches give it a distinctive appearance.

Chimaphila umbellata (L.) Nutt. Gen. 1:274. 1818.

To the report of this species in Southern California (Munz & Johnston, Bull. Torrey Club 49:355. 1922) based on a collection by Peirson in the San Bernardino Mts., there can be added its occurrence in the San Jacinto Mts. near Willow Creek, a fork of Tahquitz Creek (**Munz 6055 & 6387**), where a colony was found on shaded slopes growing in masses of *Castinopsis* at 7,000 ft. alt. On the north slopes of the ridge east of Mt. San Bernardino it acts almost as a ground cover over great areas, growing especially under **Castinopsis**, and ranges from 8,700 to 10,000 ft. alt. (**Munz 6240**).

Androsace acuta Greene. Man. Bot. San Francisco Bay, 238. 1894.

St. John retains this species in his recent revision of certain species of *Androsace* (Canada Dept. of Mines, Mem. 126:54. 1922) and cites two stations for Southern California: Crafton (**Lemmon & Parry 1184**) and San Bernardino (**Lemmon** in 1876). It has been collected also at Warners Hot Springs (**Eastwood 2594**) and in Puddingstone Canyon, San Dimas (**Munz, Street, & Williams 2424**). At the last named station it was found in small grassy spots at the top of low cliffs.

Centunculus minimus L. Sp. Pl. 116. 1753.

Previously known from several stations in San Diego County: San Diego and Ramona (**Mrs. Brandegee**, U. C. Herb.), and between Miramar and La Jolla (**Brandegee**, U. C. Herb.). It grows at Red Hill near Upland in dried winter pools on a clay mesa (**Munz 5556**).

Dodecatheon Hendersoni Gray. Bot. Gaz. 11:233. 1886.

This northern species can now be added to the flora of the San Bernardino Mts. It grows on gentle, grassy slopes under pines in Bear Valley at about 7,000 ft. alt. It had almost finished blooming on June 11, 1922 (**Munz 5676**).

Asclepias albicans Wats. Proc. Am. Acad. 24:59. 1889.

A striking plant with its erect, woody, waxy, almost leafless stems, eight feet high, and growing on rocky canyon walls of the Colorado Desert. Collected in the Piute Mts. (**Hall 6025**), at Agua Caliente (**Brandegee**, U. C. Herb.), and frequent in the Chuckwalla Mts., Eagle Mts. (**Munz & Keck 4939**), and in the pass west of the "Hayfields."

Harpagonella Palmeri Gray. Proc. Am. Acad. 11:88. 1876.

Known from several collections about San Diego and from Catalina Island (Davidson, Bull. So. Cal. Acad. 2:70. 1903); and to be reported from five miles northeast of Murietta in Riverside County, where locally abundant on dry slopes in the chaparral (**Munz & Johnston 5335a**).

Galium bifolium Wats. Bot. Kings Exped., 134. 1871.

An addition to the list of the San Antonio Mts.; occasional in Mescal Valley, forming dense patches on moist aluvial soil at 6,700 ft. alt. (**Munz 5579**).

Brandegea parviflora Wats. Rose, Contr. U. S. Nat. Herb. 5:120. 1897.

A species not common in collections but of wide distribution on the Colorado Desert: Palm Springs region (Parish, Bull. So. Cal. Acad. 2:81. 1903), Shavers Well near Mecca (**Munz & Keck 4760**), Chuckwalla Wash (**Schellenger 87**), Chuckwalla Springs (**Hall 5896**), McCoy Wash (**Hall 5948**), northwest of Blythe (**Munz & Harwood 3564**). It frequents sandy washes and in the region from Mecca eastward, it climbs over shrubs and rocks in almost every canyon.

Bahia dissecta (Gray) Britton. Trans. N. Y. Acad. Sci. 8:68. 1888.

On a trip to the San Bernardino Mts. in August, 1922, with F. W. and Mabel Peirson, their station for this species (Munz & Johnston, Bull. Torrey Club 49:359. 1922) was visited and numerous others were found, so that this plant can be said to be well distributed throughout the upper parts of the Santa Ana River system, but nowhere is it common. It inhabits sandy or gravelly soil from 6,500 to 8,700 ft. alt. (**Munz 6130, 6194, 6299**).

Franseria ilicifolia Gray. Proc. Am. Acad. 11:77. 1876.

Hall (Univ. Calif. Pub. Bot. 3:123. 1907) names several stations near the Mexican border. Occasional large, low clumps occur much further north, along the sandy Aztec Wash of the Chuckwalla Mts. (**Jaeger 1024, Munz & Keck 4782**).

Pomona College,

Claremont, California.

CLEOMELLA OBTUSIFOLIA, TORR. & FREM.

S. B. Parish

The genus Cleomella is represented in California by five species, all of the arid region east of the Sierra Nevada. With the exception of the little-known **C. alata** Eastw. all the species occur in the Mojave Desert. **C. obtusifolia** Torr. & Frem. is the most widely distributed, and the only one which reaches the Colorado Desert. It is found in alkaline or subalkaline soils from Lone Pine (**Hall** 7314) to Carrizo Creek (**Brandegee**), and extends into the adjacent borders of Nevada (Ash Meadows, **Purpus** 6044), and probably of Arizona.[1]

The type specimen of this species, collected by Fremont,[2] is now in the herbarium of the New York Botanical Garden, and was originally in the Torrey herbarium. It bears the label: "On the American Fork of the Sacramento, 1844." This region is now well known to California botanists, and as the plant had not been rediscovered in subsequent years they regarded the reported type station as one of the errors which are not unknown in Fremont's labels. But in the Death Valley Report Coville[3] stated that specimens had been recently collected in the Sacramento region. I have been unable to learn the basis for this statment, and there are no specimens from other than desert stations, in any of the principal American herbaria,[4] so that the accuracy of the reported type station remains very questionable.

Considering the condition of Fremont's party when on the American river it is exceedingly doubtful if any plants were then collected. Fremont descended that river, from its headwaters to its mouth, between the first and the eighth of May, 1843, his party disorganized and scattered, and only saved from starvation by scanty supplies of acorns and horse flesh. In their distress the daily astronomical observations, so faithfully made under discouragements, were entirely omitted. It is intrinsically improbable that under such conditions any specimens were made, least of all of inconspicuous plants not yet fully grown. The only other plant reported from this time and place is **Eriogonum reniforme** Torr., also strictly a desert species. Unless the specimens on which Coville's statement is based can be found it is best to continue to regard the reputed type station as an error. Beyond reasonable doubt both the Cleomella and the Eriogonum were really collected somewhere on the Mojave Desert, where both are abundant, and through which Fremont passed a month later.

1The only Arizona specimens I have been able to locate are very indefinitely labeled. There is one in the Gray herbarium labeled "Arizona, Lieut. Wheeler, 1871," and another in the University of California herbarium labeled on an Arizona ticket, "Mojave Desert, Lemmon & wife, May, 1884." There are no specimens from that state in the herbarium of the University of Arizona.

2Rept. Frem. 2d Exped. 311. (1845).

3Cont. U. S. Nat. Herb. 4:67. (1893).

4Namely: Gray U. S. National, N. Y. Bot. Gard. (except type), Mo. Bot. Gard., Stanford Univ. Cal., Cal. Acad. Sciences.

Cleomella obtusifolia is a species whose characters must, for the most part, be defined with a modifying "more or less," so variable are they. It shares the desert habit of promptly flowering when only an inch or two high, and under favorable conditions continuing to grow until it exceeds a foot, the stems repeatedly branching from the ground up, forming a more or less compactly bushy growth. The stems are usually green, but sometimes purplish (**Hall & Chandler** 7314), obviously or obscurely striate, glabrous, or more or less strigosely hispid. The leaflets are oblong to obovate, the apex obtuse, retuse, apiculate or even bristle-tipped (**Brandegee,** Carrizo Creek); more or less hispid below with white hairs, and sometimes sparsely so above; varying greatly in size on the same plant, a few much exceeding the others, the largest on thirty plants being 13 by 9 mm. The stipules are whitish, a narrow hyaline blade when best developed setosely lacerate, but usually reduced to a tuft of several or a few strigose hairs, or wanting. In fruit the pedicels become spreading or declined and the stipes reflexed, both organs varying in length, the pedicels from 5 to 12 mm. (average 7.6 mm.) and the stipes from 5 to 8 mm. (average 6 mm.), the full range of variation exceptionally found in different fruits of the same plant. The pedicel usually exceeds the stipe, but the two organs may be equal, or the stipe the longer. The length of the style is more definite, varying but little from 3 mm., and the narrow petals are from 3 to 5 mm. long. The character of the capsule will be considered later.

These variations are not positive, but merely varying degrees of development of the organ studied, nor are they coordinately grouped. But, such as they are, a variety and a species have been founded on certain of them, and both have been accepted, although with expressed hesitation, by Payson in his recent helpful Synoptical Revision[5] of the genus. A study of the abundant material in the herbarium of the University of California indicates that neither variety nor species can be maintained.

The only essential character of **C. obtusifolia** var. **pubesens** A. Nelson[6] is the pubescence of the stems. They are characterized by Nelson as "more or less roughened with short fragile bristles," and more specifically by Payson as "densely pubescent." Most plants have glabrous stems, but a close examination sometimes detects a rugosity on the younger growths of even apparently smooth plants. Such a roughening may be detected on **Palmer** 30 of 1876; there are some scattering hairs on **Parish** 3750; still more on a specimen collected by Greene at Lancaster; Purpus **5562** advances another degree, and his **6044** is decidedly strigose. It is not difficult to arrange such series of gradation, and nowhere can a satisfactory line be drawn.

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[5]Univ. Wyo. Publ. Bot. 1:29-46. (1922).
[6]Proc. Biol. Soc. Wash. 18. 171. (1905).

C. taurocranos A. Nels. (l. c.) is founded on the development of the valves of the capsules, which he defined as "enormously produced laterally, the broad dome-shaped bases narrowed into the slightly deflexed horns," an accurate description of an extreme form, and preferable to that of Payson, as "processes 4-5 mm. long," while the valves of the species he describes as "conical, 2-3 mm. long."

The type specimen of **C. obtusifolia** was in flower only, so that the fruit was not described. The first definition of this character is in Gray's fuller description of the species,[7] based on specimens collected by Cooper, at Soda Lake, June 1, 1861. Gray calls it a "capsula bicornuta," and he further notes that "the capsule is more strongly lobed than in any other species, the back of each valve in well developed specimens being abruptly produced into a divergent horn, three lines long, nearly as long as the style; when the valve is detached it may be likened to a corpucopia with a very flaring mouth, holding two seeds." Elsewhere[8] he describes the capsular valves as "produced mostly into a long and narrow beak," and Watson[9] describes them as "acutely and often narrowly horned." Both writers had in mind the exact form of capsule on which **C. taurocranos** was proposed, so that if the species is to be segregated on the extent to which the capsular valves are prolonged, the long-horned plants must be retained in the old species, and a new name found for the less apiculate forms.

The whole are better retained in a single species, since there is no point where a line of real difference can be drawn. In examining a large series of specimens there will be found an indefinite variation in the capsule, just as in the other organs of the plant. Nelson well describes the body of the capsular valve as "dome-shaped," but it is always more or less apiculate, from a simple projecting point, by insensible degrees to the "horn" 4-5 mm. long, which may be either straight or somewhat curved upward or downward. Usually the capsules of a single plant are fairly uniform, but there may be differences even in the two valves of the same capsule. The ovary is more or less hirsute, and so may be the mature capsule, or it may be glabrate and sinuously striate. It is impossible to maintain a segregation founded on an indeterminate variation which cannot be definitely determined, and which Payson, in his key, has reduced to the difference of a single millimeter.

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[7] Proc. Am. Acad. 7:329. (1868).
[8] Synop. Fl. 1, pt. 1. 186. (1895).
[9] Bot. Cal. 1:52. (1876).

BUTTERFLIES OF CALIFORNIA
(Continued)

DR. JOHN A. COMSTOCK

The Parnassians

Two species of these interesting mountain butterflies occur within the boundaries of our state, each of which is represented by a number of well defined varieties. There is a close similarity in all their habits. They are found at their best on the high upland meadows or sporting over precipitous mountain sides in the warmer hours of the day. One may take them easily while engaged in feeding on the numerous alpine flowers, though they are difficult to capture on the wing owing to the rough contour of the country which they usually frequent.

A peculiarity of this group of butterflies is the pouch carried on the abdomen of the female after she has mated. This brittle appendage is formed during copulation. Figure 8 of plate V illustrates this remarkable attachment. By its presence one may distinguish fertile from virgin females.

The eggs of the Parnassians are turban shaped, somewhat flattened and are covered with minute elevations. They are laid on various species of **Sedum** and **Saxifraga.** The caterpillars are flattened, and have very small heads. In color they are a dark brown or black, with numerous light spots. Pupation occurs on the ground, and the chrysalis is relatively short, and rounded at the head. When preparing to pupate the larva spins a few loose threads among the ground litter.

MENETRIE'S PARNASSIAN or CLODIUS (Parnassius clodius clodius, Men.)

Plate V. Figure 1, male, Figure 2, female

The **Menetrie's Parnassian** or **Clodius Parnassian** occurs sparingly in the Coast ranges of California from Santa Cruz north. It is exceedingly local, only two colonies so far having been definitely recorded. One of these is in the Santa Cruz Mountains, the other in Marin County. Undoubtedly diligent collecting will demonstrate a wider range. **Clodius** is on the wing in late spring and early summer. One may distinguish it from **smintheus** by the greater transparency of the outer margin of primaries, particularly in the male, and the lack of red spots in the fore wings.

Note: The typical form of this species was first taken by Capt. Wosnesenski, a member of the Russian expedition that established headquarters at Fort Ross near Cazadero. Not unlikely therefore, the type locality is Sonoma County. Our figures are somewhat darker than this typical form, coming nearer to **claudianus, Stich.** They are from Mt. Hood, Oregon.

DYAR'S PARNASSIAN (Parnassius clodius alturus, Dyar.)

Plate V, Figure 6

Dyar's Parnassian is an aberrant form of male in which the dark markings are somewhat reduced and the usual red spots are of an orange or yellow color. The type material was taken at Alturus Lake, Idaho.

THE BALDUR PARNASSIAN (Parnassius clodius baldur, Edw.)

Plate V, Figure 4, male. Figure 5, female

The Baldur Parnassian is a Sierran race of **clodius**, distinguished by its smaller size and somewhat reduced red spots. It is on the wing in July and August, and ranges from Tulare County north to the border.

LORQUIN'S PARNASSIAN (Parnassius clodius lorquini, Oberth.)

Plate V. Figure 3, male

Lorquin's Parnassian is a unique aberration of **clodius** of which, so far, only the type specimen is known. The figure is taken from Oberthur's work, and shows both sides of the butterfly, the left half of the figure representing the under side.

NOTES ON CALIFORNIA MOTHS

By Karl R. Coolidge

Noctuidæ

Acronycta strigulata Smith—Thus far recorded only from Colorado. I have a single specimen taken at light in Chino Canyon, near Palm Springs, Calif., April 22, 1922, at an elevation of 2,000 ft.

Pseudanarta ate Dyar—One specimen taken at light, Palm Springs, Calif., April 21, 1922. Dr. H. G. Dyar, of the U. S. National Museum, who kindly identified this and many other species, writes me that he possesses only the single type.

Geometridæ

Racheospila diaphana Warren — The members of the genus Racheospila are characteristic of the hot lands of America, only a few species occurring within the United States and these mostly from Florida. For the past several years, about Palm Springs, Calif., I have been taking quite commonly one of the most exquisite species of the genus, **R. diaphana** Warren, until now unrecorded from the United States. It has at least five broods at Palm Springs, the first emerging in late January or early February, another about the middle of March, a third in late May and June, a fourth in early September, and a final brood issuing towards the last of October.

Cochisea sinuaria B. & McD.—I have a single specimen of this rarity, taken at San Diego, Nov. 17, 1920, by Signor Enrico Piazza.

Notodontidæ

Ursia noctuiformis B. & McD.—A lone specimen of this rare species was taken in Chino Canyon, near Palm Springs, April 21, 1922, at an elevation of 2,000 ft.

A NEW SPECIES AND A NEW VARIETY OF NOCTUID MOTHS FROM SOUTHERN CALIFORNIA

By Chas. A. Hill, Hollywood, California

Antaplaga caliente, n. sp.

Antennae of ♂ and ♀ finely ciliated.

Head and thorax concolorous with primaries.

Abdomen clay yellow.

Ground color of primaries yellow white, with a dense scaling of grayish olive green or yellow green, about equally divided numerically, giving them together with head and thorax a finely "peppered" appearance.

Ordinary spots obsolete, with a narrow white T. A. and T. P. line, the latter being slightly out curved before middle and somewhat wider than T. A. line.

The S. T. line is faintly discernable, with a prominent white spot at apex, becoming sub obsolete before the hind angle. This spot and line is obsolete in some examples.

Secondaries translucent smoky white with a marginal band from external line outward, slightly darker. Fringe white.

Beneath, primaries and secondaries of a shining smoky white.

Expanse 23 to 29 mm.

Both sexes similar in general habitus.

Described from 18 ♂ and 5 ♀.

Locality of types: Indio, Riverside County, and Indian Wells, Southern California. October 16th to 26th, 1921.

Number and sexes of types:

Holotype ♂, allotype ♀, 17 paratype ♂ ♂, and 7 paratype ♀ ♀ all in collection of the author with the exception of 3 ♂ ♂ and 2 ♀ ♀ loaned from the collection of Karl Coolidge which I have made paratypes.

Condition of types generally good to perfect.

Named for the Agua Caliente Indians on whose reservation the types were taken.

I am indebted to Dr. Dyar for the privilege of describing this species and the following new sub species, to whom I submitted these specimens on his visit here last fall, and to Mr. Karl Coolidge for the loan of specimens, assistance through correspondence with Dr. Dyar, of both these species described in this paper.

Perigrapha puncticostata strigatteria, var. nov.

Antennae of male bipectinate, female, ciliate.

Head, thorax, legs and ground color of fore-wings concolorously ferruginous, paler than puncticostata, of which I have four specimens before me all topotypes, one probably paratype ♂ from Dr. Dyar through Karl Coolidge.

Habitus similar to **P. puncticostata** Dyar, described in "Insecutor Insecti Menstruus," but with all the ordinary lines and reniform sharply defined by a deeper shade of ferruginous, as are the nervures, bringing same out in sharp contrast.

Secondaries and abdomen concolorous, pale ferruginous with discal mark, exterior line and terminal line a brown black.

The white spots on costal margin present as in typical puncticostata.

Expanse of wings: 34 to 36 mm. Both sexes similar.

Type locality: San Diego, Calif., during February.

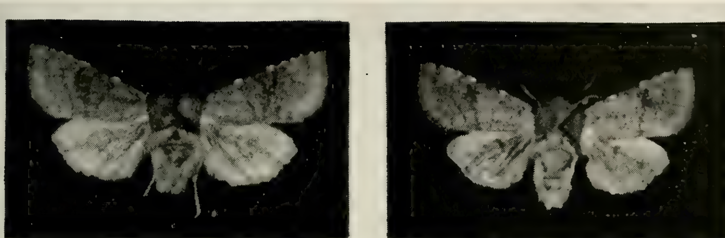
Number and sexes of type:

Holotype ♂, allotype ♀ in collection of the author and one paratype ♂, one paratype ♀ in collection of Mr. Karl Coolidge to whom I am indebted for the loan of paratypes and gift of ♀ allotype.

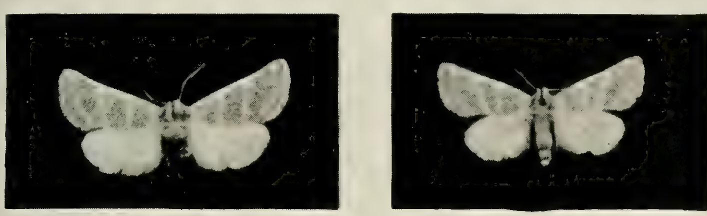
Dr. Dyar thought it worth a name, when I pointed out this form and it is with his kind suggestion that I venture to describe this striking form.

This species is closely allied to **Orthosea ferrigera** Smith of which I have three examples before me, taken on Vancouver Island, Br. Col.

The types are all in beautiful condition. The ♀ allotype is the most prominently marked specimen.



♀ *Perigrapha puncticostata strigatteria* ♂



Antaplaga caliente. ♀ *Antaplaga caliente.* ♂.

The recent receipt of a copy of "Contributions to the Natural History of the Lepidoptera of North America" by Barnes and Benjamin dated March 17, 1923, Decatur, Ill., Vol. V, No. 2 describes the above insect on page 83 as Stiria hilli, new species, so our species becomes synonomous with same. The specimen figured is therefore only topotypical, but matches a paratype in the authors collection as noted in the above publication. The exact position generically would seem to be in doubt.

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■ ■

Bulletin of the

Southern California Academy of Sciences

Began issue with Vol. I, No. 1, January, 1902. Issued ten numbers in 1902, nine numbers in 1903, 1904, 1905; three numbers in 1906. Issued two numbers annually from 1907 to 1919, both inclusive (except 1908—one issue only). Issued four numbers (January, May, July and October) in 1920.

The 1921 issues are: Vol. XX, No. 1, April; Vol. XX, No. 2, August; Vol. XX, No. 3, December.

The 1922 issues are: Vol. XXI, No. 1, March; Vol. XXI, No. 2, September.

The 1923 issues to date are: Vol. XXII, No. 1, March.

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Southern California Academy of Sciences

LOS ANGELES, CALIFORNIA

Vol. XXII Part 2

July, 1923

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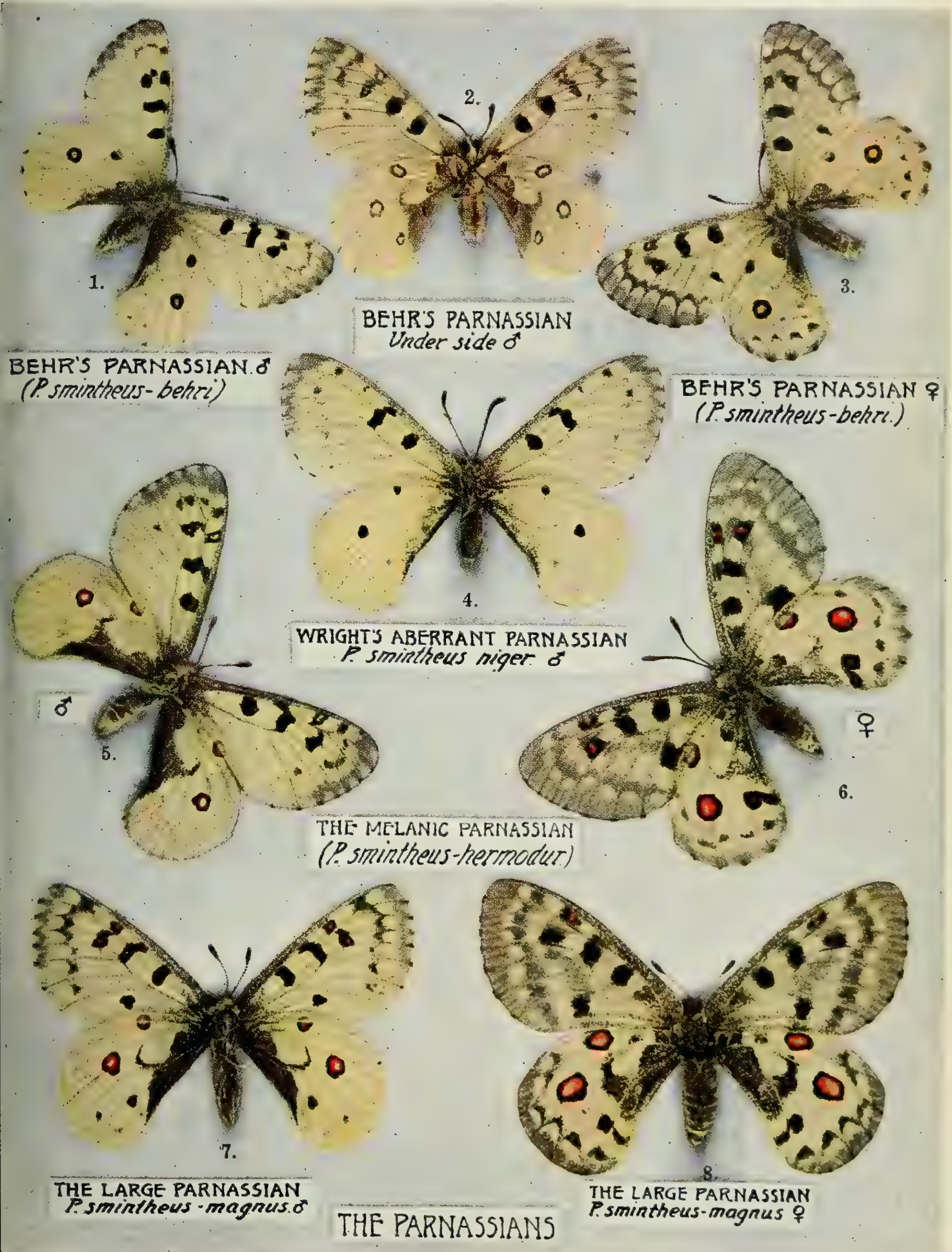


All Figures Slightly Reduced

BULLETIN OF THE
Southern California Academy of Sciences

FOSSIL SHARKS AND RAYS OF THE PACIFIC SLOPE OF NORTH AMERICA

— BY —

DAVID STARR JORDAN and HAROLD HANNIBAL

This memoir is supplemental to two papers: "The Fossil Fishes of California," Jordan, Univ. Cal. Publ. Geolcgy V. No. 7, pp. 95-144, 1907; "Supplementary Notes on Fossil Sharks," Jordan and Carl Hugh Beal, op. cit. VII, No. 11, p. 243-256, 1913, based on the same material, to which have been added various other collections from deposits, chiefly of Miocene Age, in Southern California. These additional series may be enumerated as follows:

I. Geological Collections of Stanford University, containing, besides the material previously examined, numerous other specimens from different sources, as indicated below.

(a) Kern County Miocene: The East-central part of Kern County is occupied by barren rounded hills composed of thick-bedded, friable, loosely cemented, mealy material known as Arkose. This is a rotten granite containing fragments of feldspar, quartz and epidote, washed down by Kern River from the Sierras. This deposit overlies the oil-bearing rocks which center at Oil City on Kern River three or four miles north of the City of Bakersfield. In it sharks' teeth are relatively abundant, together with teeth of Sea lions, bones of Sea-lions and whales and occasional teeth of an extinct sea-cow. It is probable that teeth exist throughout this deposit, but it can be examined only where exposed by erosion.

The principal localities known are the following: (a) **Shark-tooth Hill**, on the north side of Kern river, about four miles east of Oil City (recorded beyond as "Shark-tooth Hill").

This and Barker's Ranch in the same neighborhood have been especially studied by Charles Morrice, Secretary of an Oil Company at Oil City, and also by John Barker and by Frank B. Anderson of the California Academy of Sciences. A large collection from Anderson and Barker was sent to the Academy and was studied by Jordan before the earthquake-fire of 1906, in which all except a few duplicates sent to Stanford University were destroyed.

A still larger collection was made in 1913 by Mr. Morrice about Shark-tooth Hill at Mr. Anderson's suggestion, and sent in part to the California Academy of Sciences, in part to Stanford University. This series was the basis of the report of Jordan and Beal in 1913.

More recently, (June 1, 1923), the senior author of this paper visited this region, and Mr. Morrice turned over to Stanford University still another series, not less extensive

and valuable than those previously recorded. The various collections of Mr. Morrice are the most important yet obtained in Kern County.

(b) Poso Creek, a considerable tributary (at high water) of Kern River from the north, running for some distance parallel with the larger stream and about ten miles to the north of it. In its upper reaches this is known as Posé Creek, and in Agassiz's papers it is called Ocoya Creek, a name not now current. Along this stream and a small tributary known as Granite Canyon, examined by Dr. Jordan, the low cliffs contain shark-teeth with various disintegrated bones, probbaly of whales. On Poso Creek, at a point some ten miles north-northeast of Bakersfield, the types of Agassiz's species of 1853 were secured by Mr. W. P. Blake. These localities are recorded below as "**Poso Creek.**"

(c) Bena, from the south side of a high hill three miles northwest of Bena Station, on the Southern Pacific Railway, numerous specimens were secured by Mr. Hannibal. This locality is recorded below as "**Bena.**"

(d) Collections from Huerhero Creek, 25 miles southeast of Santa Margarita, in San Luis Obispo County, obtained by Mr. Alvin T. Schwennesen, a Stanford student in Geology. This locality is recorded as "Huerhero."

(e) Collections obtained by Mr. Walter A. Kuhnert and other students from various localities in California.

(f) Collections from the coast of Oregon and Washington obtained by Mr. Hannibal in 1911 and 1912, part of them having been examined by Jordan and Beal in 1913.

(g) Collections of Mr. Hannibal mostly from the Coast ranges of California.

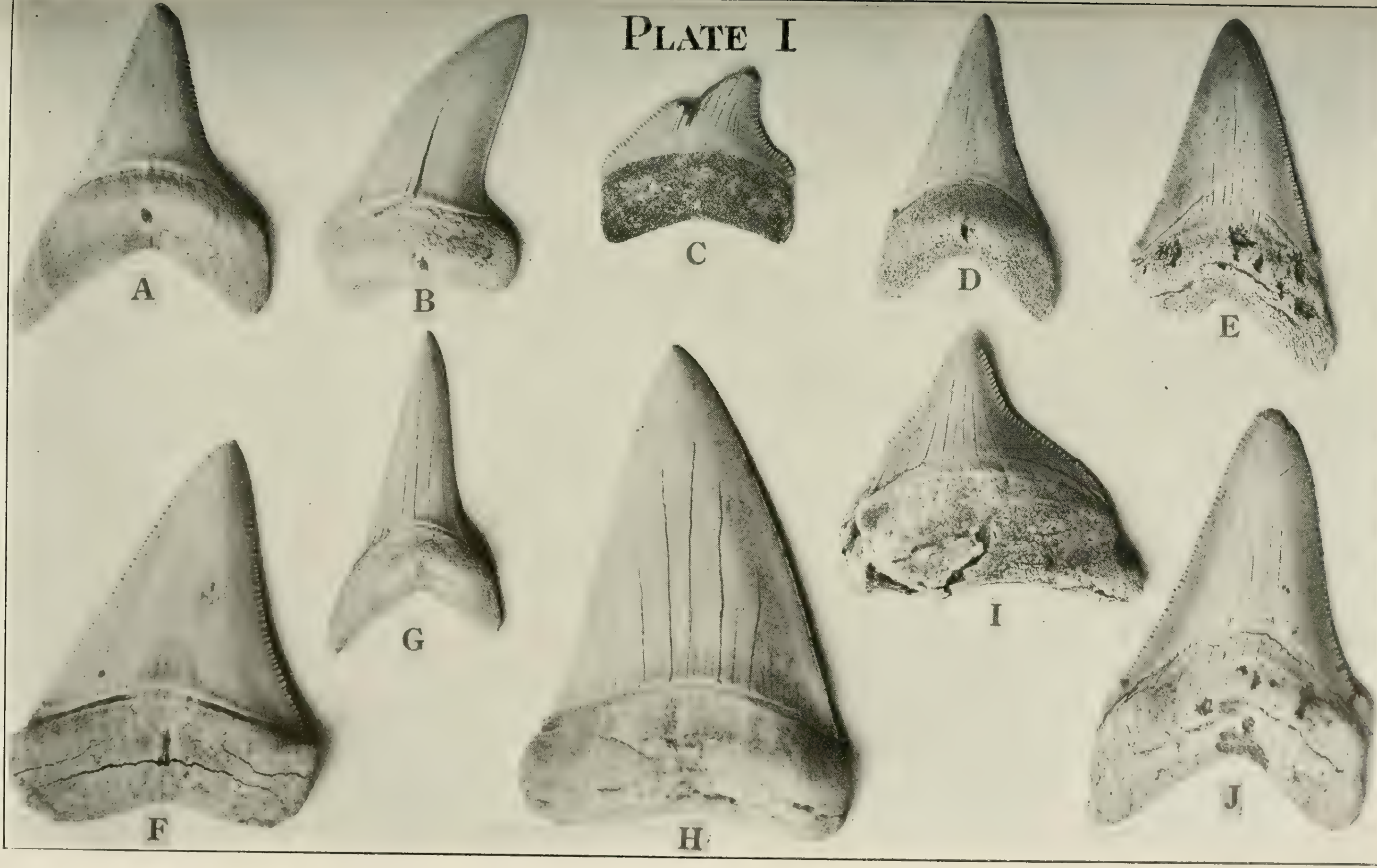
II. Collections from California and Lower California loaned by the California Academy of Sciences.

III. A collection mostly from California loaned by the Los Angeles Academy of Sciences.

IV. A collection from the Lomita Marl Pits, secured by Mr. Samuel Maus Purple, at that time general manager of the Torrance Lime and Fertilizer Company, and presented by him to the Los Angeles Museum of Natural History. The deposits are in an outlying hill of the range known as the Palos Verdes (Green Trees), about a mile from the village of Lomita and thirty miles southwest of the center of the city of Los Angeles. These deposits are so extraordinary in character and in the fossils they contain that we have prepared as an appendix to this paper a brief account of them, while commending them to the special attention of geologists and palaeontologists. The deposits contain remains of four or five species of sharks, one of them of enormous size, but no traces of other fishes.

The presence of teeth of horses and elephants in the same deposits with those of sharks and whales was at first very puzzling. It is, however, to be accounted for by the elevation and folding of the deposits, by which process a deep bay was changed to a shallow estuary, leaving, however, the folded strata continuously conformable.

PLATE I



In the American Journal of Science, III, May, 1922, p. 388-342, is a short account of this deposit, with provisional identification of the sharks' teeth, the plates duplicated in the present paper.

The writers have examined nearly all the teeth of sharks thus far recorded from the Pacific slope of North America, and of most species large numbers of individuals. A partial series of the species examined has been placed in the Southwest Museum of Los Angeles.

For purposes of illustration, the writers have included four cuts of living sharks related to fossil species.

Family HETERODONTIDÆ

It is a curious fact that this family, the only one occurring in Triassic times is not yet represented by either teeth or fin-spines in the California Miocene, although present in the Triassic and represented by a living species, **Gyropleurodus francisci** (Girard) in the California waters of today.

HYBODUS Agassiz

1. Hybodus nevadensis Wemple

Hybodus nevadensis Wemple, (Edna M.), Univ. Calif. Publ. Geol.; V. p. 72, Pl. vii, fig. 3, 1906; (Cottonwood Canyon, West Humboldt Range, Nev. Upper part of middle Triassic, Star Peak series.)

2. Hybodus shastensis Wemple

Hybodus shastensis Wemple, Univ. Calif. Publ. Geol.; V, p. 73, Pl. VII, fig. 4, 1906; (west end of Bear Cove, Shasta Co., Calif.); type 10.255 U. C., Jordan, loc. cit., p. 98, fig. 1, 1907. (Upper Triassic, Tropites beds.)

ACRODUS Agassiz

3. Acrodus alexandræ Wemple

Acrodus alexandræ Wemple, l. c. V. p. 71, VII. fig. 5-6, 1906, (Fisher Canyon, West Humboldt Range, Nev. Upper part of middle Triassic, Star Peak series.)

4. Acrodus creodontus Wemple

Acrodus creodontus Wemple, l. c. V. p. 72, Pl. VII, fig. 1-2, 1906; (Cottonwood Canyon, West Humboldt Range Nev. Upper part of middle Triassic, Star Peak series).

5. Acrodus wempliæ Jordan

Acrodus wempliæ Jordan Univ. Calif. Publ. Geol.; V. p. 100, fig. 2, 1907; (Bear Cove and north fork of Squaw Creek, Shasta Co., Calif. Upper Triassic **Tropites** beds). (Type U. C. 1090; cotype S. U. 988.)

COSMACANTHUS Agassiz

6. Cosmacanthus elegans Evans

Cosmacanthus elegans Evans, Univ. Calif. Publ. Geol., III, p. 397, P. XLVII, 1904; (Paris Canyon, Idaho, Lower Triassic, **Meekoceras** beds).

PLATE II.

7. **Cosmacanthus humboldtenis** Davidson

Cosmacanthus humboldtenis Davidson, Univ. Calif. Publ. Geol.; XI, p. 433, 2 text figs. 1919; (Straight Canyon, West Humboldt Range, Nev. Upper part of middle Triassic, Star Peak series).

ASTERAGANTHUS Agassiz

(Strophodus Agassiz)

8. **Asteracanthus shastensis** Bryant

Strophodus shastensis Bryant Univ. Calif. Publ. Geol.; VII, p. 27, 2 text figs. 1914 (Cow Creek, Shasta County, Calif. Upper Triassic, **Tropites** beds).‡

9. **Gyropleurodus francisci** (Girard)

(Plate IV. j.)

A fin spine of a Heterodontid shark (S. U. 8901) was given by Mr. Charles Morrice. It is entirely hollow, 2½ inches in height, 1 3-5 inches in breadth at base, and half an inch wide posteriorly. Compared with a similar spine of the living species of California, **Gyropleurodus francisci,** it agrees very closely in size and appearance, the main difference being that its sides are quite flat, with obscure vertical ridges. It is slightly recurved and the tip has a worn appearance. Its anterior edge is somewhat rounded, the two posterior edges angular, the concave inner surface concave. No corresponding teeth have been found.

The fresh appearance of this spine, and the fact that its hollow interior is empty, leads us to question whether it is really a fossil at all. It was presented to Mr. Morrice by a friend, Mr. James Fraser, and it may be of Pleistocene or even recent origin.

Family HEXANCHIDÆ

(Notidanidæ)

HEPTRANCHIAS Rafinesque

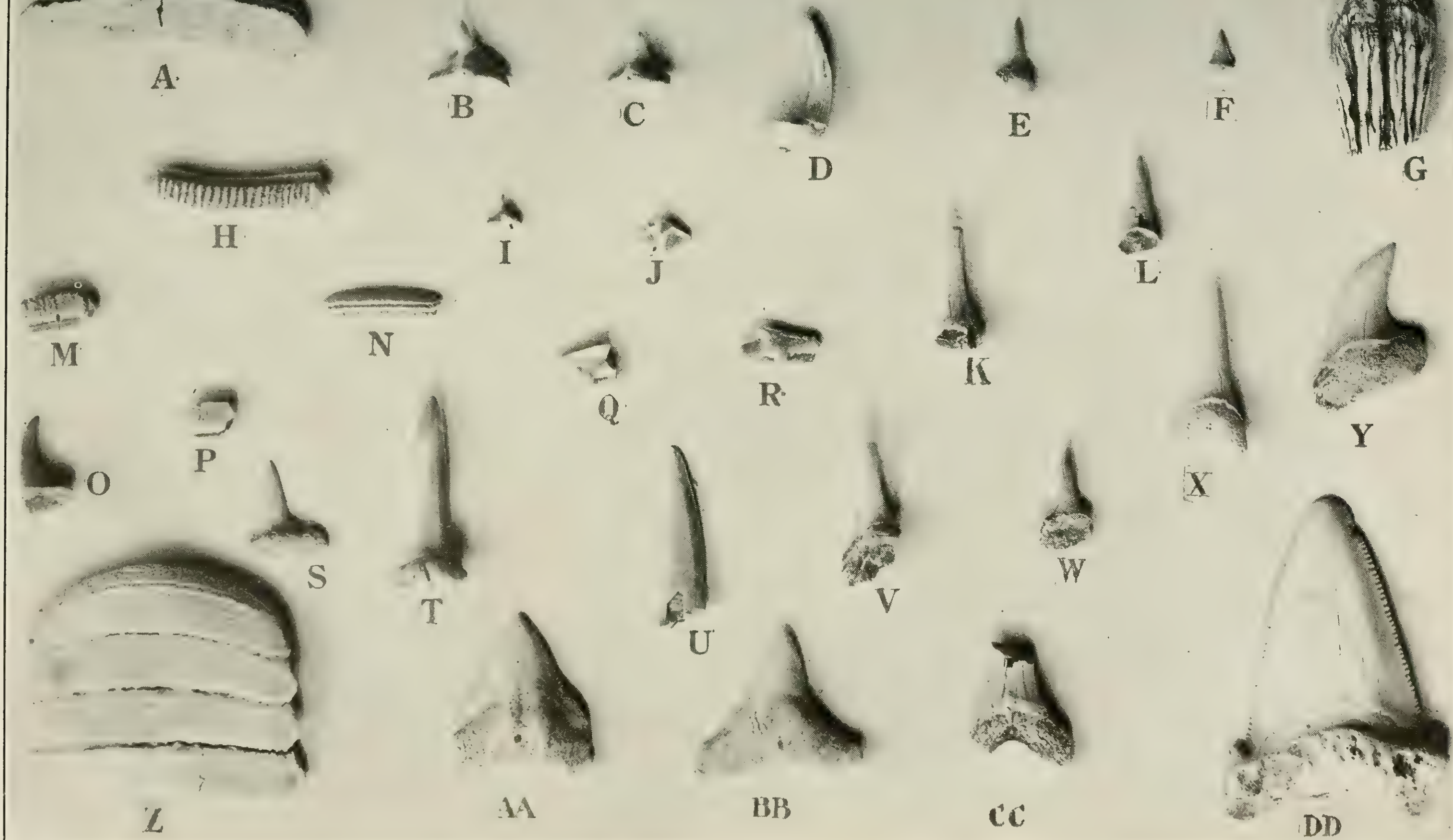
In this family, there is a wide variation in the character of the teeth. Those of the front of the upper jaw are sharp, flexuous, spear-like, without cusps or serrations. The lateral teeth of the lower jaw are comb-shaped, with a primary and some secondary cusps; the anterior base of the first cusp is often serrate; the upper lateral teeth are smaller, each with a primary cusp and some secondary cusps. Some of the submedian teeth have one large sharp cusp and one or two smaller ones at base. The lateral teeth have broad, flattened, blade-like or wedge-shaped roots, quite unlike the lunate or bifurcate roots of most other sharks. The roots of the sharp upper median teeth are narrower but heavy and never with divided or cordate base.

It is of course impossible to know whether these fossil species had seven gill slits as in **Heptranchias** and **Notorynchus** or six as in **Hexanchus (Notidanus** Cuvier).

GYROPLEURODUS Gill

‡The smooth bean-like object supposed to be a tooth of a Heterodontid shark, described as **Wodnika ocoyæ,** Jordan and Beal (Fossil Fish, S. Cal. 9, 1919) proves on detailed examination by Mr. Hannibal to be not a tooth, but a small dark chalcedony concretion, marked with faint reticulations like a tooth, and further encased in organic matter. Two more examples similar in appearance were found by Dr. Jordan in Granite Canyon. One of these, examined by Dr. Austin F. Rogers, shows no trace of organic matter. The species should therefore be stricken from the system.

PLATE III



9. **Heptranchias andersoni** Jordan

(Plate II. x. y. z. dd. ee.)

Heptranchias andersoni Jordan, Univ. Calif. Publ. Geol. V. p. 101, fig. 3, 1907; (Barker's ranch, Kern River, cotype S. U. 935 and others).

Lower lateral teeth comb-shaped with nine bluntish cusps, the first cusp placed well forward, the second smaller than the first, the others progressively smaller to the last, ten anterior serræ present on the anterior lateral teeth, wanting on those further back; median lower tooth with a strong cone and two denticles on each side, inner face of root greatly thickened; upper front teeth broad at the base, the crown sharp, slender and flexuous, with a detached denticle and several anterior serræ, the base heavy and never bifid or cordate. Upper lateral teeth not very different from the lower, but smaller, with fewer denticles.

Of this species we have many specimens from various parts of the mouth.

Monterey formation‡ at Barker's ranch; Poso Creek (S. U. 935); Bena (S. U. 950); Shark-tooth Hill (S. U. 995-960) (S. U. 906).

The tooth figured as **Squatina lerichei** (pl. VII E) in the Fossil Fishes of Southern California doubtless belongs to this species.

This species may belong to the living genus, **Notorynchus,** now common on the California coast, rather than to **Heptranchias.**

NOTIDANION Jordan and Hannibal

Notidanion Jordan and Hannibal in Jordan, Classification of Fishes, January 1923, p. 97, type **Notidanus primigenius** Agassiz.

This genus differs from **Heptranchias** in having the cusps of the lower lateral teeth few, the anterior edge of the main cusp with about five very coarse serrations or small cusps, this edge being entire or merely weakly serrate in **Heptranchias.** The upper front teeth are presumably lanciform, flexuous and entire, with undivided roots but none are in our collection.

10. **Notidanion boreale** Jordan and Hannibal, new species.

(Plate II. g.)

Type several lower lateral teeth, similar in general form to those of **N. primigenium** (S. U. 930, S. U. 932, S. U. 934). Lower teeth comb-like, the first cusp submedial, greatly enlarged; secondary cusps usually four in number, diminishing in size backward; anterior serræ six, very strong, almost as large as the secondary cusps, very much coarser than in **Heptranchias andersoni.** Length of type 20 mm.

Oligocene; San Lorenzo formation at sea-cliffs between Classen wharf and Ship Canal estuary, Port Townsend, (type); west shore of Oak Bay, Port Townsend; sea cliffs ¼ mile north of old Woodman Wharf, Port Discovery, Washington. (Coll. Hannibal.)

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‡The Monterey deposits hitherto regarded as Miocene, lie above the Oligocene deposits and just below the upper Miocene deposits which are always separated from it by unconformity. A large part of the molluscan fauna extends into the higher Miocene, however, so that the Monterey rocks may be regarded as transitional from the Oligocene to the Miocene. (H. H.) The shark-teeth of the Kern region are all from the strata known as Temblor, of the lower Monterey.

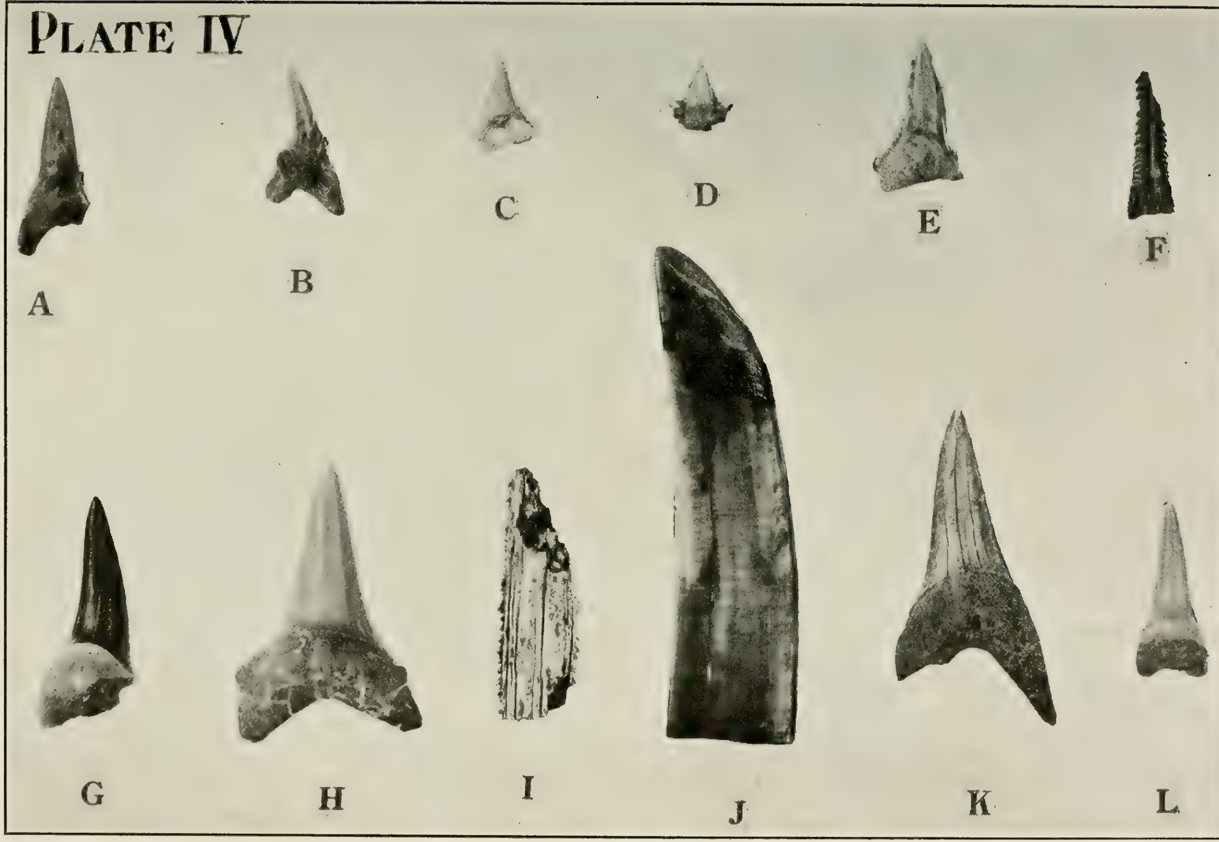

PLATE IV

The species bears a strong resemblance to **Notidanion primigenium** (Agassiz) and may prove to be the same. As most of these Pacific species have been described as distinct from their European congeners, and as all show some differences, we think it better to retain separate names, especially as the species of living sharks are, in nearly all cases where careful comparison has been made, found to be distinct. A full series of teeth is necessary in this group, for a final discrimination of species.

11. Notidanion chicone (Jordan)

Hemipristis chiconis Jordan, Univ. Calif. Publ. Geol. V. p. 105, fig. 7, 1907, (Martinez, type U. C.).

This species based on a small tooth from hard Cretaceous sandstone may be a lower side tooth of the genus **Hemipristis** as at first supposed, though it seems more likely to represent a species of **Notidanion.** The type shows the primary cusps with twelve rather strong, blunt serrations, anteriorly, the secondary cusps, if any, are broken away. The tooth figured by Jordan is subtriangular, about as broad as high, the anterior edge convex, with the point directed strongly backward, the posterior edge nearly straight with an incurved angle, the tip without serræ, as in **Hemipristis.** The root is broken and its form cannot be ascertained, and it may belong to **Hemipristis** rather than to **Notidanion.** Cretaceous, Chico formation at Martinez, California; (Coll.; Hannibal).

Family GALEORHINIDÆ

(Galeidæ; Carcharinidæ)

CARCHARHINUS* Blainville

(Carcharias Cuvier, not of Rafinesque)

The upper teeth of **Carcharhinus** are narrowly triangular; lower teeth slender and erect with lengthened roots giving the tooth a T-shaped appearance; the teeth in both jaws are more or less serrulate, the upper teeth most strongly so.

12. Carcharhinus antiquus Agassiz

(Plate II.; c. j. k. p.)

Prionodon antiquus Agassiz, Am. Jour. Sci. Art., CLXXI, pl. 273, 1856; Pac. R. R. Rpts., p. 314, Pl. I. fig. 9-13, 1856, (Poso Creek).

Carcharhinus antiquus Jordan, Univ. Calif. Publ. Geol., 1907, V. p. 103, fig. 5 (Shark-tooth Hill; Jordan and Beal). l. c. VII, 248.

Galeorhinus hannibali Jordan and Beal, Univ. Cal. Geol. VII. 247, 1913, fig. 2; (Barker's Ranch). Type S. U. 979, upper posterior tooth.

Upper teeth narrowly triangular, more or less finely serrulate from base to tip, which is reflexed toward the back of the jaw and often curved inward; anterior and posterior margins of root lengthened. Lower teeth slender, more or less coarsely serrulate at the base; tip sometimes reflexed and sometimes curved inward. Root low, much widened, slightly lunate, giving the tooth a T-shaped outline; somewhat thickened posteriorly and with nick characteristic of all species of the family. Teeth small, rarely exceeding 12 mm. in height; the extended base 15 mm. to 20.

Monterey formation, one mile west of Kern River and four miles above Oil City, (S. U. 921); Poso Creek (952 S. U.); Barker's Ranch (S. U. 951); Shark-tooth Hill; Bena.

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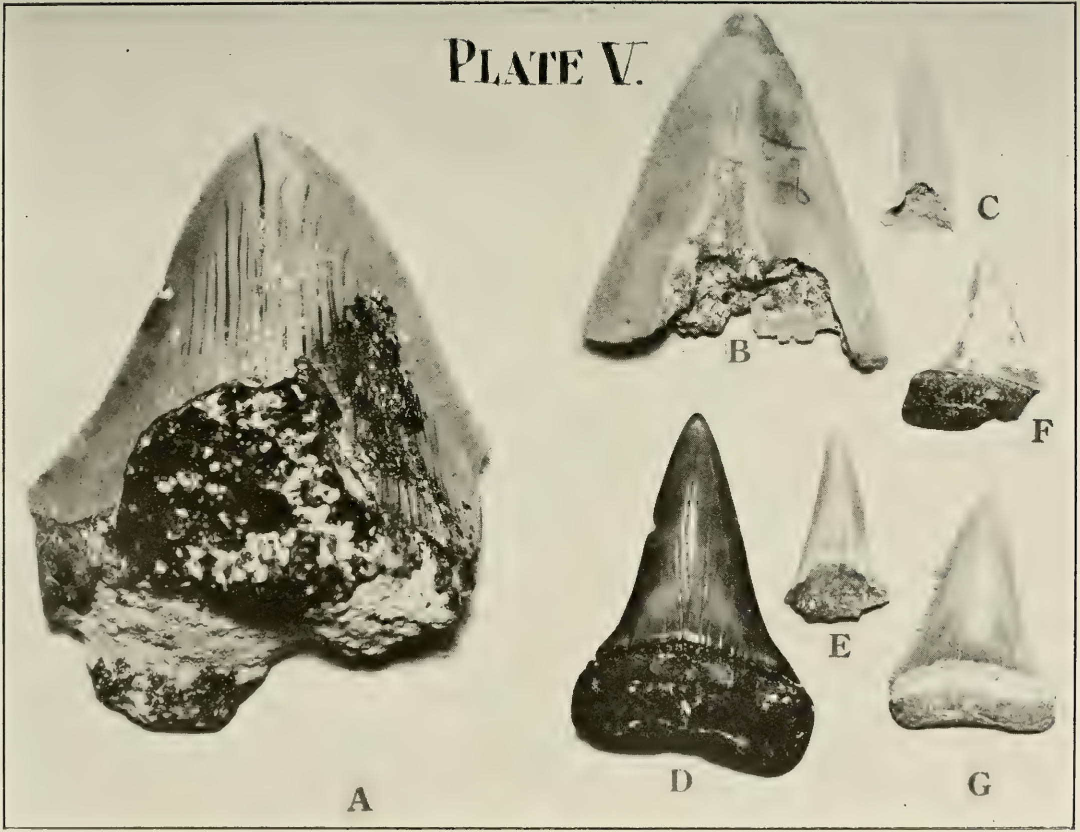
*We retain this name as restricted by Jordan and Evermann and by Garman in place of **Carcharias** Rafinesque in harmony with a decision of the International Zoological Commission.

PLATE V.



13. **Carcharhinus magdalenæ** Jordan and Hannibal, new species.

(Plate II. n. r. s. III aa. bb. (type) VI. d.)

Upper front teeth flat and equilaterally triangular, each side with 30 to 50 marginal serræ; lateral teeth narrower, more finely serrate; lower teeth slender with entire margins except at the base where a cocks-comb of about eight small, coalescing serræ is developed. Root moderately lunate, the base, as usual, thickened posteriorly with a slight median nick.

The species differs from **C. antiquus** in the larger size of the teeth, their form and the shorter root margins. We have a number of specimens representing teeth from all parts of the mouth.

Type (upper tooth), (901 S. U.) height 19 mm.; breadth 22 mm.; thickness, 5 mm.; a cotype (lower tooth) height 17 mm. length 15.5 mm.; thickness 4.5 mm. Another upper tooth (904 S. U.) has the height 19 mm.; breadth 22; depth 4½ mm.

Monterey formation, Arroyo Salido, Magdalena Bay, Lower California.

We have also a very perfect upper tooth, from the Pleistocene of the Lomita beds (S. U. 978) Plate VI. d. It is broadly triangular, the outer edge a little concave, or recurved, both edges strongly serrate to near the tip, the serræ on each side about 30. Base broad, thick, cordate, mesially nicked. Height of crown 8 mm; breadth of base 12 mm. This is probably an upper side tooth of **C. magdalenæ.** The teeth in this species differ very little from those of **Carcharhinus lamiella** Jordan and Gilbert, a living species found from San Diego southward to Magdalena Bay.

14. **Gyrace** Jordan and Hannibal

Gyrace Jordan and Hannibal in Jordan, Classification of Fishes, January, 1923, p. 100.

Type **Scymnus occidentalis** Agassiz,=**Galeocardo productus** Agassiz.

In this genus, the longer teeth are peculiarly twisted at tip and coarsely serrated at base. Upper teeth compressed, rather broadly triangular; crown strongly inclined toward the back of the jaw so that only the front margin functions as a cutting edge; crown and front base finely serrulate, rear base separated by a notch and margined with several (two to ten) strong denticles of which one near the notch is the largest.

Lower teeth inclined toward the back of the jaw, with a strong posterior notch; root much expanded, lunate, somewhat thickened at the posterior base of the crown; crown slender, highly arched, and markedly flexuous, the tip obliquely twisted so as to present a cutting edge toward the front of the mouth; crown and front base finely serrulate, rear base sometimes with a cocks-comb of coalescing denticles and sometimes merely serrulate.

This genus is clearly allied to **Galeocerdo** from which it differs in the inequality of the teeth and their serration. In **Galeocerdo,** the teeth are rigidly entire. From **Carcharhinus** and **Prionace, Gyrace** is distinguished by the strongly inclined crown of the upper teeth and the obliquely twisted crowns of the lower. The very broad, lunate root is also distinctive. As usual in this family it is somewhat thickened on the inner face with a slight median nick. One species known from the Miocene of California. **Scymnus occidentalis,** is a nominal species referred by Agassiz to a very different genus (**Scymnus=Scymnorhinus**). It seems to be identical with **Galeocerdo productus,** the description being drawn from teeth further back in the jaw. We have, however, never seen a tooth of **Gyrace** so blunt at tip as in those figured by Agassiz as **Scymnus occidentalis.**

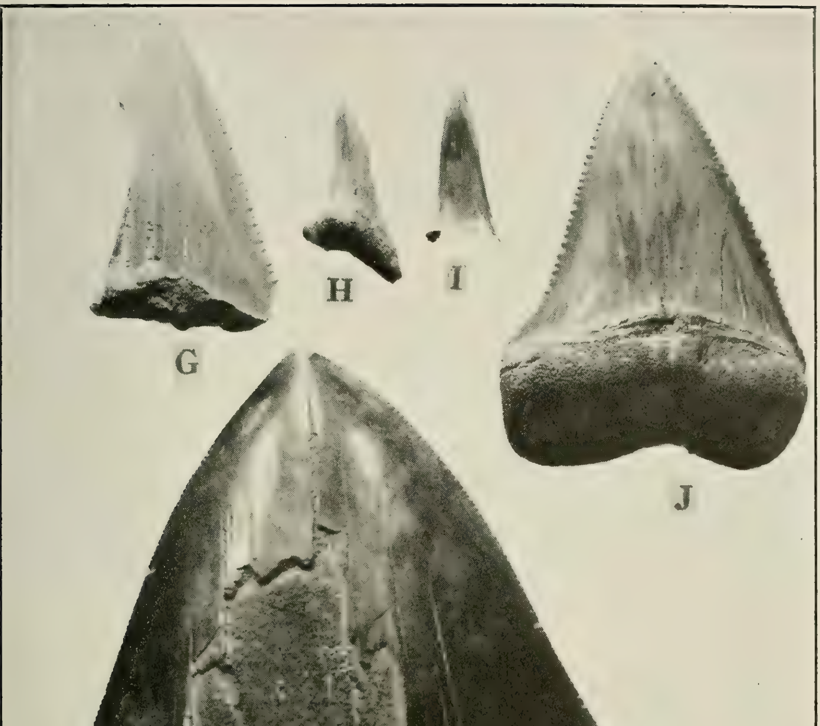


PLATE VI b.

15. **Gyrace occidentalis** Agassiz

(Plate II. b. c. d. e. f. l. m. q. cc.)

Scymnus occidentalis Agassiz, Am. Jour. Sci. Arts. CLXXI, p. 272, Pac. R. R. Rpts. V. p. 314, Pl. I, fig. 9-13, 1867, (Poso Creek), (Upper side tooth).

Galeocerdo productus Agassiz. Am. Jour. Sci. Arts. CLXXI. p. 273, 1856; Pac. R. R. Rpts. V. p. 314, Pl. I, fig. 1-6, 1856; (Poso Creek); Jordan, Univ. Calif. Publ. Geol., V. p. 101, fig. 4e, 13, 1907.

Triakis beali Jordan. Foss. Fishes So. Calif.; Stanford Univ. Publ. p. 20, Pl. VII, fig. g. 1919; (Kern River); (probably a small upper posteriorly tooth, as shown in plate II. b. i.)

Outer margin of tooth sharply and rather finely serrulate; inner margin with a deep notch, below which are two or ten coarse serrations. The very small posterior teeth are often entire—erect with flat widely extended roots, so that the tooth will stand erect when placed on a flat surface. Our many specimens agree fully with the account of **Galeocerdo productus.** They show wide variation in form, the lower teeth having very broad emarginate lunate roots while in the upper jaw the roots are narrower and considerably thickened mesially on the posterior base of the crown. We have no teeth quite so blunt as the types of **Seymnus occidentalis,** and no large ones have the roots so little emarginate.

The Monterey formation; Mission Pass, ¾ mile east of summit; Mission San Jose (S. U. 948); Barker's ranch (S. U. 944, 979, type); Poso Creek (S. U. 941); Shark-tooth Hill (S. U. 916-942); Bena (S. U. 987). The specimen from the Pliocene, Fernando formation at Temescal Canyon near Santa Monica, mentioned by Jordan and Beal, cannot belong to this species.

HEMIPRISTIS Agassiz

A well-marked genus, distinguished by the strong serration of both sides of its triangular teeth, the tip being always entire; root divided into two diverging branches; upper teeth large, broad, and flat; front lower teeth slender, subulate, and reflexed toward the throat, destitute of serrations or with only minute points at the base; rear lower teeth narrowly triangular and serrate like the upper teeth, the serræ fewer; base of crown posteriorly thickened at the root and somewhat notched, the root broad and flattened at its extremity, in the upper teeth, much narrower in the lower teeth.

The living genus, **Dirrhizodon** Klunzinger, of the Red Sea has the teeth precisely as in **Hemipristis** from which it is probably not separable.

16. **Hemipristis heteropleurus** Agassiz

(Plate II. u. v. aa. bb.)

?**Hemipristis serra** Agassiz, Poiss, Foss. III. p. 237, pl. XXVII, fig. 18, 30, 1843, (Württemburg, etc.).

Hemipristis heteropleurus Agassiz, Am. Jour. Sci. Arts. CLXXI, p. 274, 1856, (Poso Creek); Jordan, Univ. Calif. Publ. Geol., V. p. 104, fig. 6, 1907.

Upper teeth broadly triangular, bent outwards, strongly convex on the median side and concave on the outer; outer side with strong bluntish marginal serrations which do not extend to the apex which is always entire, and curved outwards; the serrations all on the thin anterior edge of the tooth; serrations on the convex median side

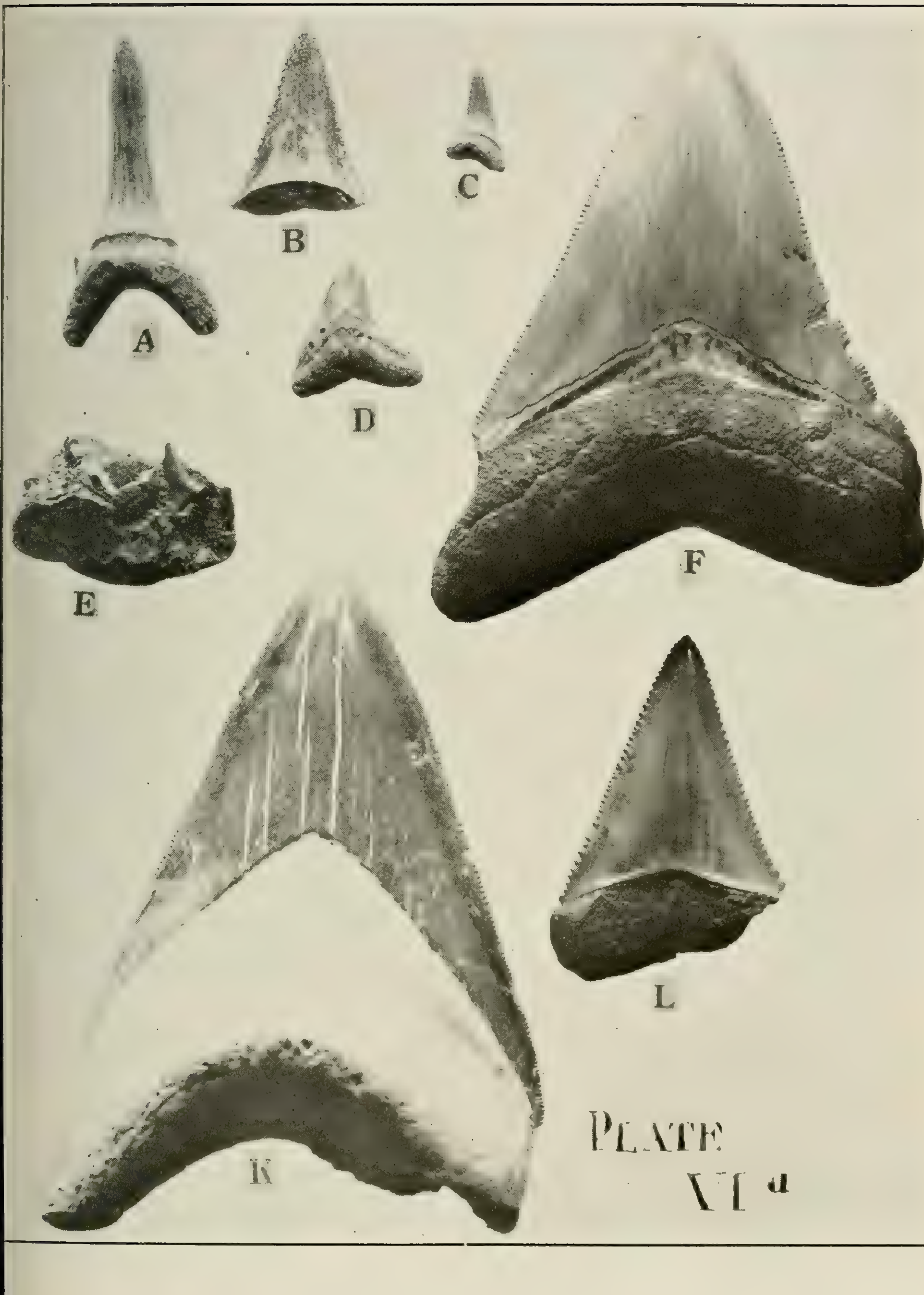


PLATE VI a

much smaller and more numerous than the others, becoming very small towards the base of the crown. Lower teeth narrowly triangular more nearly erect, both edges straighter, the serræ fewer (about 15) and more nearly equal, the tip of the crown for about one fourth its median height always entire. Root of upper teeth spreading widely, its outer edges thin, its outline cordate; base of the crown posteriorly more or less thickened; its "hump" more or less emarginate; lower teeth with narrower cordate roots, the base of the crown behind thicker.

We find no distinction between **Hemipristis heteropleurus** of California and **H. serra** of Europe, except the rather slight one noted by Agassiz, which, however, seems constant. In **H. heteropleurus** there are 19 to 24 small serræ on the convex outer or anterior edge of the tooth and 16 to 20 large ones on the concave posterior. In **H. serra,** as figured by Agassiz, there are 20 on the outer side in the upper teeth, 16 on the median. On similar teeth in **H. heteropleurus,** find the numbers 23-13, the difference between the two sides being considerable. Examples from near Chesapeake Bay referred to **H. serra** show 36-18, the uppermost on the convex side larger than in **H. heteropleurus,** the lowest very small. These last may not show in Agassiz's figure. The three forms may be identical, but for the present we retain the California name. **Hemipristis serra** has been recorded, more or less uncritically, from the Eocene, Miocene, and Pliocene of Germany, France, Malta, Java, Maryland, South Carolina and Colon. Of **Hemipristis heteropleurus,** we have examples from the Monterey formation at Barker's ranch, (927 S. U.), Bena, Poso Creek (S. U. 994). Also from Huerhero Creek, (946 S. U.) from Arroyo Salido, Magdalena Bay, (926 S. U.) and from the Pleistocene at Pacific Beach, near San Diego. Next to **Isurus hastalis,** it is the most abundant of the fossil sharks in California.

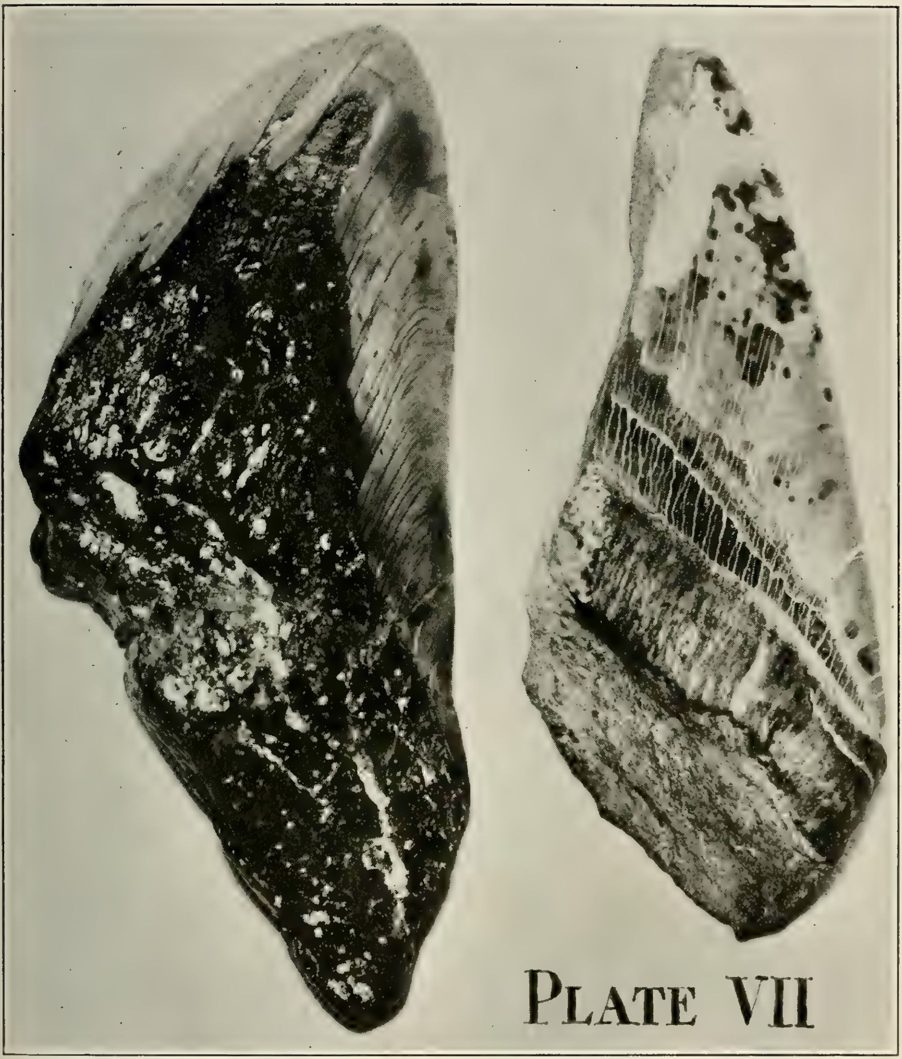
XIPHODOLAMIA Leidy

Xiphodolamia Leidy, Jour. Ac. Nat. Sci. Phila. VIII, 252, type **X. ensis** Leidy.

This genus is especially characterized by the narrow, lunate root which is irregularly triangular in cross section. The inner face of the crown is so thickened at base as to form a "hump" the tooth standing obliquely erect when set on a flat surface. The two halves of the root are always unequal, the one nearest the median line being the shorter. The crown is slender, pointed, sharp-edged, somewhat flexuous, some of the upper teeth coarsely and irregularly dentate on the lower half of the crown; the serræ smaller, sharper, and fewer than in the lower teeth of **Hemipristis.** These are arranged along the cutting edge on the front angle of the tooth.

The lower front teeth, if correctly understood by us are longer, more erect, more slender, with the edges strictly entire. On teeth of this type, the genus was originally based and it is possible that to such it should be restricted. These we now regard as the front lower teeth of the same species as the serrate teeth named **Carcharias morricei.**

Dr. Woodward suggests that **Xiphodolamia** may be based on front teeth of **Heptranchias,** but the narrow lunate roots, thickened on the anterior lower part of the crown, forming a low hump nicked at top, distinguish the teeth of **Xiphodolamia** from the flexuous front teeth of **Hexanchidæ** which have solid roots, not in the least lunate.



17. **Xiphodolamia morricei** Jordan and Beal

Plate VI. h. (type), IV. a. b. e. II. t. (lower front tooth)

Carcharias morricei Jordan and Beal, Univ. Calif. Publ. Geol. VII, p. 249, fig. c. 1913, (Shark-tooth Hill) (S. U. 982).

In the original type example, (plate VI. p.) the root is broken. The crown has a rather large, sharp, double denticle on the posterior margin below the middle, with trace of a similar double one on the anterior margin.

Another example since obtained has six coarse serræ or denticles on the posterior edge of the crown, below its middle and one on the anterior edge with very fine serræ above it. These two teeth are suberect and apparently median, their denticles much like the serræ in **Hemipristis.**

A third example is a lateral tooth, very slender and sharp, the point directed inward and backward, somewhat flexuous, the posterior edge with five small denticles, the anterior with but one. Base of tooth narrow, deeply and obliquely lunate, the large anterior protuberance making it triangular or "three-legged" so that it will stand oblique, though not erect, as in **Echinorhinus** and **Squatina.** The crown is more flattened and sharper on the edge than in **Xiphodolamia ensis,** but less so than in **Hemipristis.**

All our specimens are from Shark-tooth Hill, obtained by Mr. Morrice, a most assiduous collector of such material. The species has something in common with **Hemipristis paucidens** Agassiz, which species, or one very similar, we have from Chesapeake Bay, and which is probably based on lower side teeth of **Hemipristis serra.**

This species has proved peculiarly puzzling to the writers. Its teeth bear no resemblance to those of **Hemipristis heteropleurus,** except to certain small posterior ones, and none of the back teeth among our specimens of **Hemipristis serra,** from Maryland, however erect or however few the serræ, are exactly parallel with our examples of **H. morricei.** In this connection, it is also possible that the genus **Xiphodolamia** is based on the long, entire front teeth of some species of **Hemipristis.** In order to avoid the confusion possible from the introduction of intenable synonyms, we refer **morricei** provisionally to the genus **Xiphodolamia.**

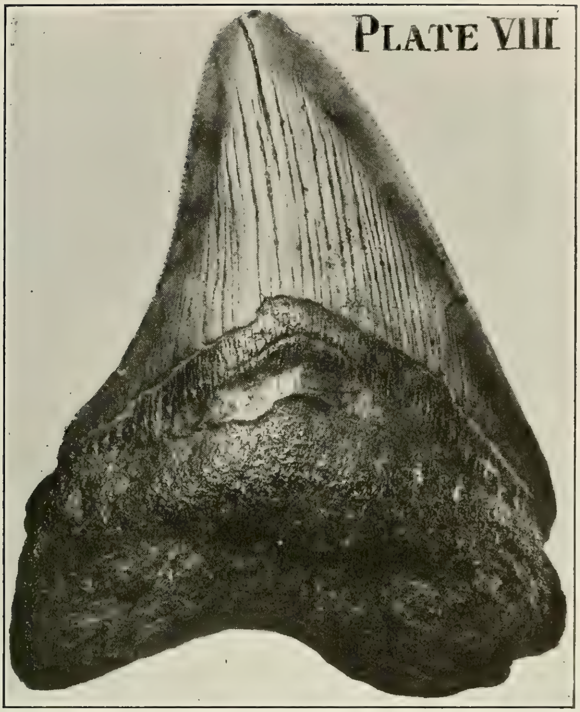
Another example shows the following traits: front lower teeth

very long, slender, flexuous, recurved, with the margin entire and sharply keeled, especially at the distal end; inner face smoothly polished, the outer face rounded, the crown slender and bent backward, the root rather narrow, lunate, thickened at base interiorly, a feature well shown in plate II, t.

In our best example of this form, from Shark-tooth Hill, (Acad. Sci.) (Plate II, t.) the crown is high, slender, nearly erect, flexuous, with very sharp entire edges. It is greatly thickened posteriorly at the junction with the root, the "hump" thus formed being slightly notched. The root is short, thick, deeply cordate. We assume, without proof, that this is a lower front tooth of the species called **X. morricei.**

Total height 30 mm., height of crown 21, breadth of root, 15.

This specimen well exhibits the main character of the genus, the notched hump at the base of the crown behind, the crown being without serrations. It much resembles the type of the genus, **Xiphodo!mia ensis** Leidy, described from the Miocene of New Jersey, and of which we have many specimens from the Miocene of Chesapeake Beach. The crown is however narrower, more acute, flatter and with sharper edges than in **X. ensis.** The basal hump is placed rather lower in **X. ensis,** and the tooth will stand "three-legged," but not erect, when placed on end.



Family CARCHARIIDÆ

(Odontaspidæ)

CARCHARIAS Rafinesque (1810)

(Not of Cuvier, 1817; **Odontaspis** Agassiz, 1835; **Triglochis** Muller and Henle, 1838.)

As Rafinesque mentioned one species only under his genus **Carcharias, C. taurus,** the name cannot lawfully be transferred to the group called by Blainville, **Carcharhinus,** which, as restricted by Jordan and Evermann, is the **Carcharias** of Cuvier. The **Carcharias** of Rafinesque was intended as the equivalent of **Carcharodon,** as his **Carcharias lamia,** later named by him in the "Indice," was **Carcharodon carcharias** and not a species referable to **Carcharias** Cuvier.

Teeth with the edges entire, the upper awl-shaped, the lower lanciform, flexuous, most of them with a denticle on each side at base, as in **Lamna;** lower teeth slender, with strongly bifurcate more or less wide-spreading roots, not thickened massially; the crown with a spongy or honeycomb structure within, as in the **Lamnidæ;** this is sometimes destroyed in broken teeth, leaving the crown hollow. The teeth are not always certainly distinguishable from those of **Lamna,** although in general more slender. The root is much more expanded than in **Xiphodolamia,** and there is no posterior hump at base of the crown. Any or all of the following species may belong to **Lamna.**

19. **Carcharias clavatus** (Agassiz)

(Plate II. a. h.)

Lamna clavata Agassiz, Am. Jour. Sci. Arts. CLXXI, p. 275, 1856. Pac. R. R. Rpts., V. p. 316, Pl. I. fig. 19-21, 1856, (Poso Creek); Jordan, Univ. Calif. Publ. Geol., V. p. 106, fig. 8, 1907.

Teeth slender, the edges rounded, somewhat flattened and recurved at the tip, basal denticles usually present, set well down on the root which is shallow, broad and very deeply lunate. Leriche observes (translated): "This species was provided with symphyseal teeth and should therefore be referred to the genus **Odontaspis (Carcharias).**"

Monterey formation; Poso Creek (914 S. U.); Shark-tooth Hill: Miocene deposit, three miles west of Coalinga, (F. M. Anderson).

20. **Carcharias ornatus** (Agassiz)

(Plate III. v. w.)

Lamna ornata Agassiz. Am. Jour. Sci. Arts. CLXXI, p. 275, 1856; Pac. R. R. Rpts. V, p. 316 Pl. I, fig. 28, 1856, ("Navy Point," correctly "Army Point,") Benicia.

Lamna appendiculata Jordan and Beal, l. c. 250 (Martinez; Port Gregory) (not of Agassiz, European species).

Central teeth long, slender and strongly recurved with keeled edges and a distinct sharp basal denticle, easily broken on each side; side teeth smaller and flatter, mostly lacking basal denticle; convex faces of the crown ornamented with numerous incised grooves, these sometimes absent in the side teeth. Base of tooth somewhat thickened, but without hump, broad, apparently little cordate.

This species is clearly related to **Lamna elegans** Agassiz of the Tertiary of Europe and the Atlantic States, a species now placed in **Carcharias.** This arrangement we may provisionally follow.

Chico formation (Cretaceous) at Martinez; one mile north of Brightside station in Niles Canyon (S. U. 943); Army Point, Benicia; ¾-1½ miles south of Cannon station, Solano County; Suisun Hill, Solano County; South Marysville Butte. Also in the Eocene, Arago formation at seacliffs between Big Creek and Cape Gregory, Oregon. This specimen is mentioned by Jordan and Beal (1 c. p. 250) as possibly identical with **Lamna appendiculata.**

21. **Carcharias virgatulus** Jordan and Hannibal, new species.

(Plate III. t. u.)

Two teeth from San Diego represent a species with the teeth long, slender, straight, distinctly less tapering than the front teeth of **Isurus,** and blunted at tip, the edges strongly keeled and the inner face rather strongly grooved; outer face flat, slightly recurved at tip. Denticles if present broken off. Root not expanded, thick, sharply emarginate, but without hump.

Length of crown in type 22 mm. base 9 mm. depth 6 mm. The specimens are from Pleistocene deposits, San Diego formation at Pacific Beach, a suburb of San Diego. (Coll. Ac. Sci.) A specimen from the same horizon at Lomita, (Plate VI, e.) having the same obtusely tapering crown seems to belong to this species.

We place this well-marked species provisionally in **Carcharias.** Its roots are narrower than in **Lamna,** the crown is thickened and notched at base, and there is no trace of denticle on the large tooth. It is very much straighter and less tapering at tip than in **C. sanctæcrucis.**


PLATE IX
A
B
C
D
E
F
G
H
I
J
K

22. **Carcharias sanctæ-crucis** Jordan and Hannibal, new species.

(Plate III. d. k.)

Teeth of a shark small, slender and flexuous, strongly recurved, occur in various places in California, especially in the Santa Cruz mountains. One, the type (plate III d.) is from the Vaqueros formation, about two miles East of Mindigo Hill, Alpine district; one from San Lorenzo deposits (Summit Road) two miles southwest of Portolá; and one from Huerhero Creek, Santa Margarita, Monterey formation.

The root is broken, but seems to have been narrow, and without hump behind at the base of the crown; no denticles are present in any specimen.

The Portolá example has the height of the crown 11 mm., its breadth at base 7, the depth 6 mm. The type from the Vaqueros (937 S. U.) has the greatly recurved crown 13½ mm. its breadth 6 mm. and depth 5 mm. Not knowing where else to place this species we leave it provisionally in **Carcharias**, in which genus, some species have the front teeth as strongly recurved.

A tooth from the Cretaceous, Chico formation, at Martinez, was doubtfully identified by Jordan with **Isurus desori** (Agassiz) from Tertiary deposits in Germany and Switzerland. The crown is long, slender, flexuous, without basal denticles, and with a narrow base. It may belong to the present species, which in turn may not belong to **Carcharias.**

Isurus, species near **desori,** Jordan, Univ. Cal. Publ. Geol. V, 112, 1907 (Martinez).

23. **Carcharias lomitæ** Jordan and Hannibal, new species.

(Plate VI. i. c.)

Anterior teeth slender, flexuous, rather obtusely pointed and sharp-edged, considerably curved, the anterior face slightly convex (the root broken off, leaving the tooth hollow). Edges of crown entire. A tooth from further back is a shade broader and less curved, its anterior face more convex; a lateral tooth is relatively broader with a strong lunate base, the crown bent to one side; both faces convex, the anterior most so.

Height of crown in type example, (974 S. U.) 25 mm., breadth near base, 8; depth 3. No trace of denticle, which may, however, be lost with the root of the two larger teeth. Crown without grooves; no hump at root of crown posteriorly.

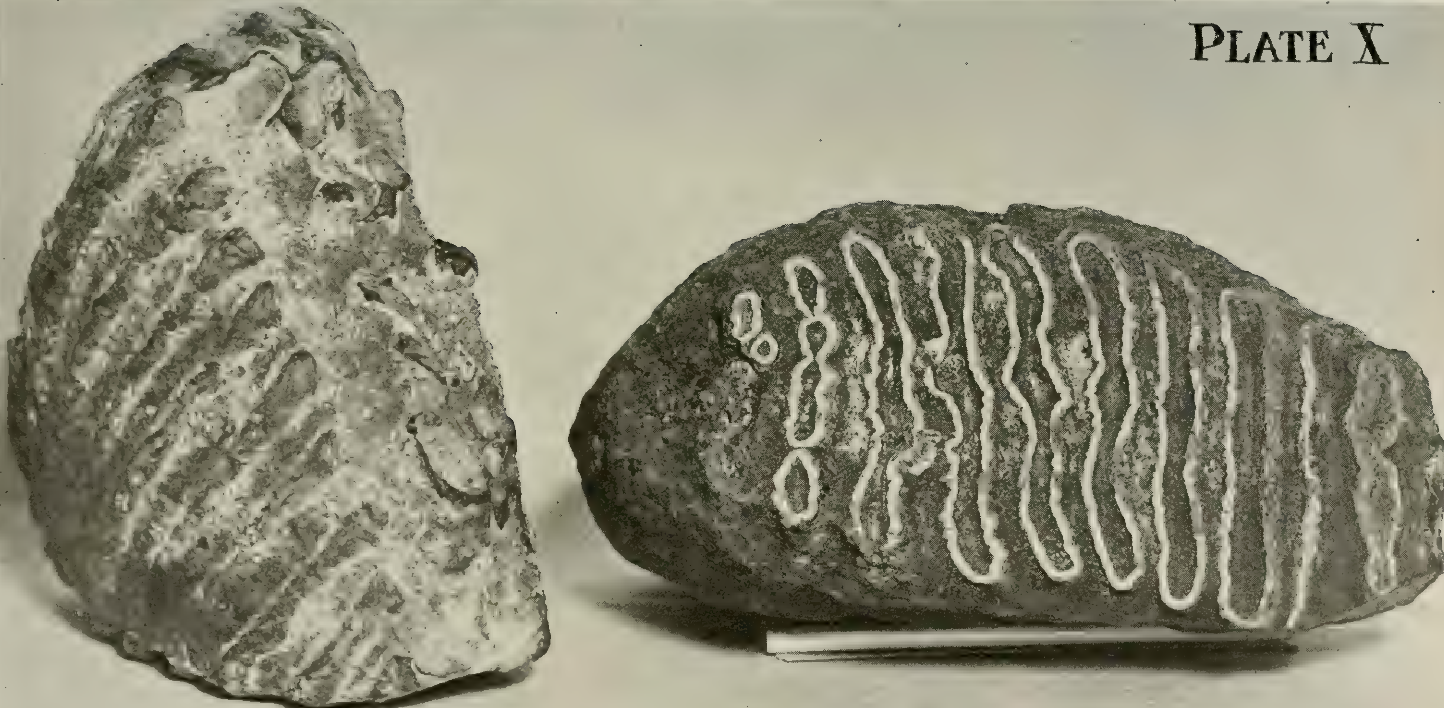
These cannot belong to **Isurus** as the lateral teeth are too narrow, the anterior ones too slender, and too strongly curved. From **Carcharias,** only the apparent absence of denticles seems to separate it. The hollow crown, with the absence of posterior hump separates it from **Xiphodolamia.** Several examples from the Pleistocene of Lomita. We are by no means sure where this species belongs. Its strong curvature suggests relations with **Carcharias sanctæ-crucis.**

Family LAMNIDÆ

In this family, the interior of each tooth has a spongy or honeycomb-like structure which may be washed out, wholly or in part, leaving the tooth hollow.

The two recognized genera in California are very closely related. **Lamna** having denticles at the base of each of the principal

PLATE X



teeth, while in **Isurus**, these are never developed. The teeth in **Lamna** are more slender than those of **Isurus**, and we cannot always distinguish them from those of **Carcharias**, in which the crown is usually still more slender. The root is very broadly lunate and there is no "hump" at the base of the crown as in **Xiphodolamia**. Two of our species described as **Lamna** are here referred to **Carcharias**.

LAMNA Cuvier

The teeth of **Lamna** have flat spreading roots, and basal denticles set at the base of the side of the crown, which is usually marked with incised grooves, though this character varies according to the position of the tooth in the mouth. On some of the lateral teeth denticles are wanting, and these are not easily separated from **Isurus**.

24. **Lamna caurina** Jordan and Hannibal, new species.

(Plate III. o. s.)

From the Oligocene of Washington we have several slender, flexuous teeth (S. U. 903), larger, broader, and less obliquely inclined than the teeth of **Carcharias ornatus** and ornamented with strong incised grooves on the inner faces; basal denticles if present broken away, probably one present on each side; in larger teeth, the root is thickened and spreads widely but without "hump," apparently little cordate; the crown tapers gradually with its edges sharply keeled for its entire length.

Length of crown 17 mm., breadth of crown 7 mm. depth 5 mm.

This species may belong to **Carcharias**. On the other hand all the species here referred to **Carcharias** may belong to **Lamna**, a species of which genus is still living on both sides of the Pacific.

Oligocene, San Lorenzo formation, sea-cliffs ¼ mile north of old Woodman wharf, Port Discovery (type); sea-cliffs between Classen wharf and Ship Canal estuary, Port Townsend, (S. U. 936).

ISURUS Rafinesque

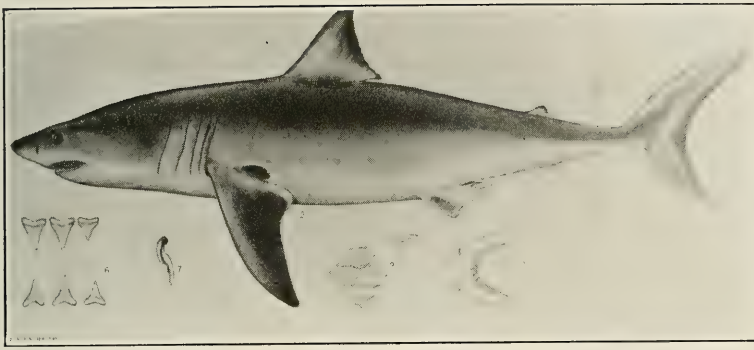
(**Oxyrhina** Agassiz; **Isuropsis** Gill)

Teeth with entire edges, never with denticles at base; front teeth lanceolate, erect, little flexuous, those posterior becoming by degrees broader at base, more or less triangular, the points curved backward so that the outer margin is concave. No hump or special convexity on the inner base of the crown. Root concave in outline, broad in large teeth, narrower in others. The nominal genus **Isuropsis** Gill is based on **Isurus glaucus**. It is defined by the backward insertion of the dorsal fin, a character found also, according to Garman, in the Mediterranean type of the genus, **Isurus oxyrhynchus** Rafinesque.

25. **Isurus hastalis** Agassiz

(Plate I, b. g. h.; plate III. g. x. y.; plate V, d. e. f.)

Oxyrhina hastalis Agassiz, Poiss, Foss. III, p. 277, Pl. XXXIV (excepting figs. 1, 2, 14.) 1843 (Württemberg; Kressenburg, Rhine Valley) recorded from various parts of the world, a common fossil species reaching a very large size—40 feet or more.



Carearodon Carcharias

PLATE XI.

Oxyrhina plana Agassiz, Am. Jour. Sci. Arts. CLXXI, p. 274, 1856, Pac. R. R. Rpts., V. p. 315, Pl. I, fig. 29-30, 1856, (Poso Creek; "Ocoya").

Isurus planus Jordan, Univ. Calif. Publ. Geol V, p. 107, fig. 9, 1907.

Oxyrhina tumula Agassiz, Am. Jour. Sci. Arts. CLXXI, p. 274, 1856, Pac. R. R. Rpts., V, p. 316, Pl. I, fig. 26-27, 36-37, 42-44, 1856, Poso Creek (heavy lateral teeth).

Isurus tumulus Jordan, loc. cit., p. 109, fig. 10-11. 1907.

Isurus smithii Jordan, loc. cit., p. 111, fig. 12, 1907, (Barker's ranch); three miles west of Coalinga. (Slender front teeth S. U. 985 Co. type.)

Isurus hastalis Jordan and Beal, Univ. Calif. Publ. Geol., VII, p. 250, 1913, Jordan, Foss, fishes. So. Calif.; Stanford Univ. Publ., p. 21, Pl. VII, fig. A-D, H, 1919.

A great variety of specimens from the California Miocene of an extinct giant **Isurus** or "Mackerel Shark" seem to be referable to a single species, **Isurus hastalis.** The local form **Isurus planus** has been, however, provisionally regarded as distinct from **Isurus hastalis** of Europe on account of a slight difference in the contour of the outer face of the erect lower teeth.

In **planus** the outer face is flat or slightly arched while in **hastalis** it is more or less concave with an obsolete raised ridge down the middle. The oblique teeth are ridged in both species. We have however, one example from near the Basalt Columns at Stanford University which agrees perfectly with the European form as figured by Agassiz. The inner face has an obscure rounded median ridge and the tip is incurved. In **Isurus hastalis,** the lower front teeth are erect and slender (**smithii**), the lower rear teeth erect, triangular with the root very heavy (**tumulus**), and the upper lateral teeth obliquely triangular, deeply notched posteriorly, (**planus**).

From the Lomita beds we have a tooth the crown of which (Plate V. d.) is 1¼ inches high, narrowly triangular and nearly erect, but thicker at the base than any other specimen seen, the root being very thick and scarcely cordate below. A lateral tooth from the same deposits has a very thick root. These Pleistocene fishes may represent a distinct species.

Localities: Eocene; Tejon formation, northeast of Oyster Point, Monto Diablo; Miocene; Mesa de Las Aceras, San Cristobal, Lower California; Monterey formation, Poso Creek, (S. U. 902) Barker's ranch; (S. U. 909, 911, hundreds of examples); Shark-tooth Hill, (S. U. 902 and 996, many). South and west slope of Pyramid Hill; near Bena; Devil's Den Oil field; Shark-tooth Hill; north bank of Kern River ten miles above Bakersfield, Huerhero Creek, (S. U. 905, 906) Lompoc, in breccia overlying deposits of diatoms; Santiago Canyon near Santa Ana; six miles north of Santa Ana; near basalt columns on San Francisquito Creek, Stanford University, (S. U. 922 two examples); O'Neal's ranch near Point Arena; Empire formation at submerged jetty, Coos Bay, Oregon, (S. U. 907, 962, 913). Tejon formation; Tassajero Canyon, Monto Diablo. Carrizo formation, at Carrizo Creek, California. Pleistocene, San Diego formation at San Pedro, and at Lomita marl pits.

In the collection from the Los Angeles Museum is a flat tongue-shaped fossil about an inch long with rounded tip and edges, and marked with coarse longitudinal furrows, about an inch long, (plate III g.). It was at first unknown to us. We find, however, in the living **Isurus glaucus** of the California coast, a flat tongue-shaped cartilage occupying the place of the median tooth in each jaw, and evidently corresponding to the fossil above mentioned, which must belong to the jaw of **Isurus hastalis.** It is shown in plate III g. We have now several other fossils of similar character but a little more elongate, from Shark-tooth Hill.

This species is by far the most abundant of the fossil sharks of the Pacific slope. It is found on both sides of the Atlantic and recorded from the Eocene to the Pliocene. Numerous examples from the Miocene about Chesapeake Bay seem to be precisely like the California form. But on both coasts there is great variation among the specimens referred to the species, and perhaps more than one species is represented among the smaller examples.

Isurus hastalis was a very much larger fish than the living type of the genus, **Isurus oxyrhynchus** Rafinesque but the teeth are much the same in form.

22A. **Isurus** species.

A broken front tooth of what is perhaps a different species of **Isurus** was obtained by Mr. Hannibal from Arago (Eocene) deposits at the sea cliffs between Cape Gregory and Big Creek, Coos Bay, (S. U. 960).

It is slender, strongly convex on both faces with a very flat root; edges of crown obtusely keeled, the inner face rather strongly striate. Spread of root 16 mm. It seems to differ from **Isurus hastalis** in the very convex faces, as well as in its position in a much older deposit. In view of the scanty material we figure it (plate III g.) without assigning a name.

26. **Isurus sanctæ-claræ** Jordan and Hannibal, new species.

(Plate III. e. f.; plate VI. e.)

Teeth very small, smaller and more delicate than even in the living **Isurus glaucus.** Crown erect, the inner face flat, the margin sharper, acute-edged for the entire length, the outer face smoothly rounded and not grooved; root spreading widely and not especially thickened behind.

Carcharhinus Lamia

PLATE XII.

Of this small shark we have numerous specimens from the mountains about the Santa Clara Valley, from deposits regarded as Oligocene. The front teeth are almost needle-like; the lateral teeth are very small, narrowly triangular, with a very flat crown.

The type from East of Mindigo Hill, Alpine district, Santa Clara County (Vaqueros formation) (S. U. 925) has the height of crown 9 mm., breadth 2½ mm., its depth 2½. One from San Emigdio Canyon, near Tejon Pass (San Lorenzo formation) has the length of crown 4½ mm., breadth 4 mm. depth 2½ mm. This is regarded as Oligocene. Another is from the mouth of Los Coches Canyon near Milpitas in Santa Clara County. Monterey formation (S. U. 931). Another which seems to belong to the same species (S. U. 981) is from the Chico formation (Cretaceous) at Martinez: this is represented in plate VI. fig. e.

Family CARCHARODONTIDÆ

(Great white Sharks or Man Eaters)

This group is distinguished from the **Lamnidæ** by the triangular teeth which are serrated on the edge and much alike in the different parts of the jaws.

In the principal genus, **Carcharodon,** there are no basal denticles. These are present in the extinct genus, **Carcharocles,** which differs from **Carcharodon** much as **Lamna** from **Isurus.**

In either genus, it is impossible to determine with certainty which of the numerous nominal species are really valid forms, and which represent merely stages of growth or teeth from different parts of the jaw.

CARCHARODON (Smith) Müller and Henle

To this group belong the largest of all shark-teeth and the animals must have been the mightiest of all fishes. The triangular teeth are always serrate, more or less strongly, the number of serrations in each species being somewhat constant; anterior teeth with a broad base and a narrow, pointed crown. No basal denticle, as the genus is here limited. Root broad, lunate, without posterior protuberance.

27. **Carcharodon branneri** Jordan

(Plate VI. f. (type); V. a.)

Carcharodon branneri Jordan, Univ. Cal. Publ. Geol. V. 116, fig. 15, 1907. (Bolinas Bay, Marin Co.; type); Jordan, Amer. Jour. Sci. III, 1922, 338, (Lomita).

This species of giant shark is based on an example from the Pliocene at Bolinas Bay (S. U. 970). The crown is medially 40 mm. high, the slant height 50, and the median height including root about 60. the slant height 80. The tooth is broad, subtriangular, slightly turned aside and recurved, the front face considerably convex transversely, the inner side flat, the tip incurved. The broad deep base is not very thick, moderately lunate. Thickness of root about 10 mm.

Serrations small, but evident, about 80 in number on each side, those near the tip becoming very fine.

Of this huge **Carcharodon,** we have specimens from Miocene, Monterey deposits, as follows: Shark-tooth Hill (S. U. 917); Barker's ranch; Bena; San Felician placers, Los Angeles County; hills back of Lake Merritt, Oakland, California. Mesa de las Aceras, San Cristobal, Lower California.

Pliocene: Purisima formation at Bolinas Bay.

Pleistocene, San Pedro formation, Lomita.

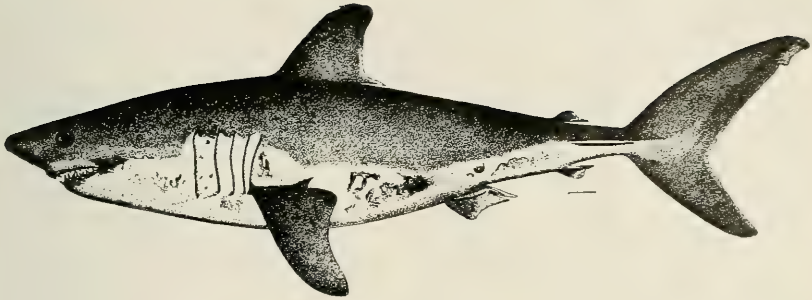
From Lomita, we figure one tooth which corresponds very closely to the original type of **Carcharodon branneri** (plate V. a.). This tooth is more erect than the others, the front edge quite flat and the back quite convex. It is serrulate to the tip, the serræ a little coarser than in the type, all bluntish and about eighty to be counted, some others broken off.

The species has been often identified with the huge **Carcharodon megalodon** Charlesworth, recorded from both sides of the Atlantic. Of the American form referred to this species, we have several examples, (S. U. 982, 983) from the Miocene near Charleston, South Carolina. Two of these we figure. One of these teeth from Ashley and Cooper Rivers is very large, broad and thick, with the lateral serrations very small (plate VI, m). It has the median height of the crown, 82 mm., its breadth 110 at base, its slant height 95, the thickness of the base 25, serrations very fine, 125 in number. Another tooth, one of several from the Eocene of Polk Co., Florida, pl. VI, k. (A. H. Ohnsong) considerably narrower and with the base extremely lunate, has the median height of the crown 50 mm., the slant height 81, the basal width 65, the thickness at base 22, the serrations fine but much coarser, 132 in number. In this specimen, and others from the same locality, leaching has turned the base white and removed part of the enamel. These hardly seem to belong to the species called **Carcharodon mortoni,** although some other teeth in the same series are more or less intermediate in form.

All these individuals have the inner face of the tooth quite flat, while in **C. branneri** it is somewhat concave or incurved.

It is not certain that the form, found in the Miocene and Eocene from Maryland to Florida, is the same as the European **Carcharodon megalodon.** The latter, as figured by Agassiz, has, like the American species, a deep heavy root. The serræ in **C. megalodon,** are stronger, about 90 in number, the tip of the tooth less obtuse and its anterior face with an obsolete median ridge. The form (Plate VI, m.) from South Carolina (Ashley and Cooper Rivers) has been named **Carcharodon mortoni** by Gibbes (Proc. Ac. Nat. Sci. Phila. 1847, 266).

In any case it seems evident that the type of **Carcharodon branneri** is not the same as **megalodon** or its American cognate, the less lunate root, not more than half as thick in proportion, indicate a tangible difference, as well as the stronger and fewer serrations. **C.**



Lamna Nasus

PLATE XIII.

branneri is more like **C. riversi** but in that form the serrations are stronger and the thickened root is still less lunate.

28. **Carcharodon leviathan** Jordan and Hannibal, new species.

Carcharodon branneri Jordan, Amer. Jour. Sci. III, 338, 1922, (Lomita, not of 1907).

(Plate VII.; plate VIII.)

Of this form we figure three examples, two of them (plate VII) from the Purple collection in the Los Angeles Academy from the Pleistocene at Lomita. These are more like **C. megalodon** than **C. branneri,** and are perhaps the largest shark-teeth yet recorded. The two teeth are about equal in size and both somewhat broken. The largest has the crown, three inches in median height (60 mm. above the thickened base, its slant height six inches (110 mm.) the breadth at base about 60 mm., the very minute serrations not to be exactly counted, the number not less than 150. Crown set somewhat obliquely, the front face a little convex, nearly vertical. Tip blunt, rather more so than in **C. megalodon** or **C. branneri.** Serrations extremely small, scarcely perceptible, the side of the tooth forming a knife edge. Root broken in both examples, but much thicker than in **C. branneri,** broader and more deeply lunate.

We give this form a provisional name, though not quite certain what may be a final verdict as to the species of these huge fishes. The type is in the Los Angeles Academy of Sciences. The co-type is S. U. 1,000.

Of a smaller but perfect example, we have a photograph, (plate VIII), from an asphaltum deposit near Los Angeles; no details were given.

As the living man-eater (**Carcharodon carcharias**) has teeth only about an inch long, with a total length of body 35 to 40 feet, the present form with teeth four inches long must have had a length in life of 125 to 150 feet, the mightiest of all leviathans.

29. **Carcharodon arnoldi** Jordan

(Plate VI. j. (type) I. f.; VI. j.)

Carcharodon arnoldi Jordan, Univ. Cal. Publ. V, 113, 1907 (Pliocene at Pescadero) (type S. U. 971); Jordan and Beal, op. cit. 1913, 252, Jordan and Gilbert, Fossil Fish S. Cal. 22, 1919, (Pliocene, Los Angeles, Pliocene, Port Los Angeles, Orange County); Jordan and Gilbert, (Fossil Fish, Lompoc, 9, 1920; Lompoc, in breccia overlying the diatom deposits).

In addition to the localities named above, we have examples from Shark-tooth Hill, Poso Creek (S. U. 919); Bena, near Calabasas (S. U. 920); Carrizo Creek; Huerhero Creek (S. U. 923, 943); from the breccia overlying the diatom masses at Lompoc.

This is by far the commonest species of **Carcharodon** in deposits of California, most frequent in the Pliocene; teeth much smaller and narrower than those of **Carcharodon branneri**, and more coarsely serrate. Serræ fewer, about 40, extending to the tip. The teeth are much larger than in the living **Carcharodon carcharias**, and broader, with more serræ than in **Carcharodon purplei**, the serræ also smaller. The basal portion is cordate, much less deeply emarginate than in **Carcharocles rectus**.

Pliocene, Purisima formation, Pescadero, Santa Cruz Co., west side of Kettleman Hills at 1332 hill. Fernando formation at San Fernando reservoir; head of middle fork of Topo Canyon, Santa Susana Mountains, (S. U. 974).

Pleistocene, San Diego formation (S. U. 914) clay pits at San Diego brick yard; Pacific Beach; Fourth and Hill Streets, Los Angeles; Lomita marl pits (S. U. 976) Port Los Angeles.

30. **Carcharodon riversi** Jordan

(Plate V. b.)

Carcharodon riversi Jordan, Univ. Cal. Publ. V. 115, 1907; Pliocene at Santa Monica (type); Rustic Canon, near Santa Monica, Zapato Chino, Fresno Co.

The teeth referred provisionally to this species are larger, broader and more erect than the type of **Carcharodon arnoldi**. We have elsewhere regarded the two species as identical, representing different parts of the mouth. But in view of all the uncertainties in this highly varied genus we may provisionally let the name stand.

Besides the original specimens named above, we have two from the Pleistocene at Lomita (plate V. b). Height of crown about 50 mm., breadth about 40; serrations about 50, none on the tip.

31. **Carcharodon purplei** Jordan and Hannibal ,new species.

(Plate V. g.; VI. b.)

Type (S. U. 974) from the Pleistocene deposits in the Lomita marl pits. The crown is 42 mm. in height, the breadth at base 30, its thickness about 7, the root broken.

Its form is nearer that of the living "Man-Eater," **Carcharodon carcharias** than any of the other species; the crown narrowly triangular, the edges more flexuous, the serræ stronger and sharper than in **C. arnoldi**, 32 to 35 in each side, the median serræ larger than those at base or tip; tip of tooth sharp, without serræ. Base of tooth broad, height of crown 23 mm. width 19, near base, depth 5.

Several other examples, most of them larger, the largest having the crown 45 mm. high were obtained by Mr. Samuel Maus Purple from the Lomita beds (S. U. 971). The base of the tooth is broad, lunate, the serræ 35 to 45, all sharp, stronger than in **S. arnoldi**, in which species the crown is much broader. The base of the tooth is 1¼ in the crown. In no case is the root intact.

The species is named for Mr. Purple, the tireless explorer of the Lomita beds, under his charge.

32. **Carcharocles** Jordan and Hannibal

Carcharocles (Jordan and Hannibal) Jordan, Classification Fishes, 99, 1923.

(Type **Squalus auriculatus Blainville**)

Teeth similar to **Carcharodon** but with a distinct denticle on each side on the base of the crown of the larger teeth, the crown narrower

Notorhynchus Maculatus

PLATE XIV.

and more recurved than in **Carcharodon**, edges of tooth and usually the denticles also uniformly and rather coarsely serrulate; the broad root extremely lunate in the anterior teeth.

33. **Carcharocles rectus** Agassiz

(Plate I, a. c. f. j. d. e. i. j.)

Carcharodon rectus Agassiz, Am. Jour. Sci. Arts, CLXXI, p. 274, 1856; Pac. R. R. Rpts., V. p. 315, Pl. I, fig. 34-41, 1856, (Poso Creek).

Teeth similar to those of **Carcharodon arnoldi**, the crown in the anterior teeth more narrowly triangular, the broad base more strongly lunate, in the anterior teeth. Posterior teeth very low and broad without denticles (Plate I, i.) the base thick; denticles varying in different parts of the mouth, easily broken and becoming gradually obsolete backward; the anterior teeth very straight; denticles of the larger teeth serrate, more or less joined to the base of the cone; serrations of crown much as in **Carcharodon arnoldi**, the number 40 to 60.

This shark is not rare in Kern County. We have two specimens from Shark-tooth Hill (Mrs. Metcalf) (S. U. 991), and two (S. U. 990, 917) from Mr. Morrice. Others are from Bena, one from north of Mesa de las Aceras, San Cristobal, Lower California (Acad. Sci.).

Two species similar to this but larger, and with the crown more feebly serrate have been described by R. W. Gibbes from the Ashley-Cooper beds near Charleston. These are regarded by Gibbes as Eocene. One of these, **Carcharodon acutidens Gibbes**, with the lateral denticles separate from the crown, we have compared with **C. rectus**, from which it is plainly distinct. The other **C. lanciformis Gibbes** is said to have the denticles connected with the crown, as in **C. rectus.** This we have not seen.

Family SCYMNORHINIDÆ

ECHINORHINUS Blainville

34. **Echinorhinus blakei** Agassiz

(Plate IV. c. d.)

Echinorhinus blakei Agassiz, Am. Jour. Sci. Arts. CLXXI, p. 272, 1856; U. S. Pac. R. R. Rpt. V. 313, Pl. 1, fig. 7-8, 1856 (Ocoya, now Poso Creek).

Monterey Age, Temblor formation. Of this species we have seen but two examples, (S. U. 992) from Shark-tooth Hill.

The one is a median tooth which is perfectly erect, triangular, thickened below, with two smaller cusps at its base, similar in form and nature, and nearly half as long, these springing out nearly at right angles; no other denticles; edges of all entire. The root is much thickened anteriorly, behind with a hump as in **Xiphodolamia.** It is sub-triangular in section, and not lunate. It stands erect when placed on the table as is the case with **Squatina,** but the root is shorter and thicker than in that genus. A second example, probably a sub-median tooth, is higher, sharper, the tip lightly turned outward, with the lateral denticles greatly reduced not one-eighth the height of the main cusp, the base greatly thickened.

Agassiz's figure representing a lateral tooth, shows it as low and broad with a low, non-cordate root which has a median projection, the main cusp turned to one side, though not horizontal, its median border forming the cutting edge; its length twice that of the two lateral cusps. Cusps all bluntish, entire. According to Agassiz, the main point of the tooth is more prominent and at the same time shorter than in the living species, **Echinorhinus brucus** (Bonnaterre,) (**spinosus** Gmelin), "the marginal denticles being smaller."

Our specimens presented by Mr. Morrice, are probably identical with the species obtained by Mr. W. P. Blake for Agassiz in the same vicinity. Apparently it is correctly placed in the rare genus **Echinorhinus,** no longer represented in the Pacific. The teeth are however more erect than in the living species.

Family SQUALIDÆ

SQUALUS Linnæus

Teeth compressed, sectorial, alike in both jaws with oblique cusp and a cutting edge nearly parallel to the edge of the jaw; each tooth with a median enameled tubercle extending from the crown forward and downward across the front of the root. Dorsal fins each with a strong spine in front.

35. **Squalus serriculus** Jordan and Hannibal, new species.

(Plate III. q.' r.)

Teeth small, compressed, shaped like a cocks-comb with a single posterior cone; one margin forming the functional cutting edge, outer edge very finely serrulate; base of tooth thin, with a tubercle of enamel that extends down over the front of the root, as in **Squalus acanthias.** Lower teeth longer than upper. We have numerous specimens of this species which is distinguished from the living **Squalus suckleyi** of the coast by the finely serrulate teeth which have however precisely the same form. In all other **Squalidæ,** the teeth are entire.

Type, (lower tooth) height 6 mm., length of base, 11.5 mm., depth 2.5 mm.; cotype, (upper tooth) height 6 mm., length 8 mm., thickness 2.5 mm.

Shark-tooth Hill (Morrice) type (S. U. 937); Bena, (S. U. 939).

This is the first fossil of this family found in American deposits and the few recorded from Europe are all more or less doubtful.

Family SQUATINIDÆ

SQUATINA Dumeril

In this genus, the small teeth are slender, erect, entire, without denticles, the base of the crown extended inward over the root, with a small obtuse ridge extending from the crown to the distal margin. The root is large, extended, not lunate, thick and flattish below, so formed that a detached tooth will stand erect when placed on a table.

36. **Squatina lerichei** Jordan and Beal

(Plate III. b. c. i. j.)

Squatina lerichei Jordan and Beal, Univ. Calif. Publ. Geol. VII. p. 253, fig. B, 1913 (Shark-tooth Hill); many examples, most of them obtained by Mr. Morrice.

Upper teeth slender, erect, and entire; lower teeth somewhat broader, the crown tilted toward the throat. Root of tooth large, broad, not cordate. An elevated ridge extending from the crown to the distal margin, with usually a rounded process on the other side.

The numerous teeth called **Squatina lerichei** by Jordan and Beal, as also others since received from Mr. Morrice, seem to be exactly like with those of the living **Squatina californica** of the coast, a species not yet clearly separated from **Squatina squatina** of Atlantic waters. They are larger and more clavate than the teeth of **Squatina japonica Bleeker.** As we know nothing of the other traits of **Squatina lerichei** and as Miocene fishes of California with no known exception are distinct from living species we retain the name given by Jordan and Beal, in honor of the distinguished Belgian paleontologist.

Monterey formation; Barker's ranch (S. U. 947); one Shark-tooth Hill (S. U. 986 type; S. U. 999).

Family UROLOPHIDÆ

UROBATIS Garman

37. **Urobatis halleri** Cooper

Urolophus halleri Cooper, Proc. Cal. Ac. Nat. Sci. III, 95, 1863, (San Diego, living), Arnold, Mem. Cal. Ac. Sci. III, 346, 1903.

Arnold refers a fossil sting of a ray from the Pleistocene of San Pedro to this species, on the authority of Dr. C. H. Gilbert. This species cannot perhaps be certainly known from this appendage.

Family AETOBATIDÆ

AETOBATUS Blainville

(**Myliobatis** Dumeril)

The Eagle rays are characterized by the presence of several functional series of flat, pavement-like teeth, forming hexagonal plates. In the present genus the large median plates are flanked on each side by a few rows of smaller ones. Each tooth has many short narrow roots, arranged comb-fashion. These are sometimes subequal; in other cases the median roots are longer. The caudal spine or sting is very large and sharply serrate.

38. **Aetobatus smithii** Jordan and Beal

(Plate III. a. h. n. IV. f.)

Zygobatis species, Agassiz, Pac. R. R. Rpt. V. 316, fig. (Poso Creek).
Rhinoptera smithii Jordan and Beal, Univ. Cal. Publ. Zool. VII, 254, fig. b. (Barker's ranch) (co-type S. U. 989).

We have many examples more or less broken from Poso Creek (S. U. 957) Shark-tooth Hill (S. U. 958, 959). Barker's ranch, Bena.

Central row of teeth hexagonal, the length 5 to 5¾ times in the breadth; in the upper jaw flat and straight, in the lower jaw slightly convex with the ends curved toward the front of the mouth; three short lateral rows on each side; grinding surface much thinner than in **merriami** and the rootlets longer, the median ones often longer than the outer. These teeth differ in no essential particular from those of the living **Aetobatus** of the coast, (**A. californicus**). But for

reasons explained under the head of **Squatina lerichei** we prefer to retain the name given the Miocene form. Broken spines of this sting-ray (S. U. 997) occur in some abundance with the teeth, at Shark-tooth Hill.

Monterey formation, Arroyo Salido, Magdalena Bay, Lower California (S. U. 952); Poso Creek; Barker's ranch; Shark-tooth Hill; Kern River; Bena; San Pablo formation; blue conglomerates, on ridge between Kirker Creek and Lawlor ravine, near Pittsburg, California (S. U. 954); Jacalitos formation, three miles west of Coalinga (Anderson).

Pleistocene, San Diego formation, Nob Hill, San Pedro. Upper San Pedro formation, Signal Hill, Long Beach.

39. **Aetobatus merriami** Jordan and Beal

(Plate III. z. IV. i.)

Myliobatis merriami Jordan and Beal. Univ. Calif. Publ. Geol., VII, p. 256, fig. d., 1913, (mile west of Kern River and four miles above Oil City.)

Central row of teeth hexagonal, the length 5 in the breadth; in the lower jaw very convex with the ends curved strongly forward, probably one lateral row present on each side; grinding surface greatly thickened, a bony structure supporting the enamel; supporting laminæ coarser than **Aetobatus smithi** and not so deep. Teeth firmer than in **A. smithii.** A few stings larger than those attributed to **A. smithii and** with the edges less sharply serrate, come from Shark-tooth Hill (Morrice) (S. U. 998). They may be referred to this species.

40. **Aetobatus aragonis** Jordan and Hannibal, new species.

(Plate III. m. p.)

Central row of molar teeth with the same relative proportions and thickness of the grinding surface as in **Aetobatus smithii** and **A. californicus**; supporting laminæ thinner, deeper, and more closely appressed. We have two imperfect specimens and several fragments of this species, which is characteristic of the Eocene, as the others are of the Miocene.

Breadth of plate 5 mm., thickness 4 mm.,

This species is from Eocene deposits, Arago formations, sea-cliffs between Big Creek and Cape Gregory; Coos Bay, Oregon (type S. U. 956). Eocene, Tejon formation, head of Spring Branch, Potrero Hills, Solano County, California (S. U. 955).

GEOLOGIC RANGE OF FOSSIL SHARKS AND RAYS OF THE PACIFIC COAST[1]

TRIASSIC

Lower Trias—**Meekoceras** beds:

Cosmacanthus elegans

Middle Trias—Star Peak series:

Hybodus nevadensis
Acrodus alexandræ
Acrodus creodontus
Cosmacanthus humboldtensis

Upper Trias—**Tropites** beds:

Hybodus shastensis
Acrodus wempliæ
Asteracanthus shastensis

CRETACEOUS

Upper Cretaceous—Chico formation:

Notidanion chicone
Carcharias ornatus
Carcharias sanctæ-crucis
Isurus sanctæ-claræ

EOCENE

Tejon formation:

Isurus hastalis

Arago formation (including California localities at Oroville, Table Mountain, Marysville, Buttes, Potrero Hills and Corral Hollow:

Carcharias ornatus
Isurus, species
Aetobatus aragonis

OLIGOCENE

San Lorenzo formation:

Notidanion boreale
Lamna caurina
Isurus sanctæ-claræ
Carcharias sanctæ-crucis

Vaqueros formation—**Pecten-Magnolia** beds:

Isurus sanctæ-claræ
Carcharias sanctæ-crucis

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[1]The classification of tertiary formations follow the outline proposed by Arnold, R., and Hannibal, H.; Proc. Am. Phil. Soc. LII. No. 212, p. 559-605, Pl. XXXVII, XLVIII, 1913, except that the term Purisima is preferred to Merced and the San Diego formation and its equivalents are correlated with the recently described interglacial Mazwood formation of the North Pacific Coast.

Beds equivalent to Vaqueros, Magdalena Bay, Lower California:

Hemipristis heteropleurus
Carcharinus magdalenæ
Isurus hastalis
Aetobatus smithii

TRANSITIONAL OLIGOCENE—MIOCENE

Monterey period (including Temblor formation):

Heptranchias andersoni
Hemipristis heteroplueurus
Carcharhinus antiquus
Gyrace occidentalis
Xiphodolamia morricei
Carcharias clavatus
Isurus hastalis
Isurus sanctæ-claræ
Xiphodolamia morricei
Carcharodon branneri
Carcharodon arnoldi
Carcharocles rectus
Squalus serriculus
Echinorhinus blakei
Squatina lerichei
Aetobatus smithii

MIOCENE

San Pablo formation:

Aetobatus smithii

Jacalitos formation:

Isurus hastalis
Aetobatus smithii

Empire formation:

Isurus hastalis

Carrizo formation:

Isurus hastalis
Carcharodon arnoldi

PLIOCENE

Purisima formation (Merced formation of Arnold and Hannibal, 1913, not of Lawson, 1893 and 1914 which includes post-Pleistocene strata in type section):

Carcharodon branneri
Carcharodon arnoldi

Fernando formation (southern equivalent of Purisima, based on type section at Los Angeles aqueduct dam):

Heptranchias andersoni
Gyrace occidentalis
Carcharodon arnoldi

PLEISTOCENE

San Diego formation (including Deadman Island, lower San Pedro, Santa Barbara, and Lomita beds, southern equivalents of interglacial Maywood formation on Vancouver Island):

Hemipristis heteropleurus
Carcharhinus magdalenæ
Carcharias virgatulus
Carcharias lomitæ
Carcharodon riversi
Carcharodon purplei
Carcharodon branneri
Aetobatus smithii

Upper San Pedro formation:

Urobatis halleri

APPENDIX

FAUNA OF THE LOMITA MARL PITS

The series of rounded hills known as Palos Verdes extend northward from San Pedro for a distance of twenty miles or more. The rocks are uncovered in but few places, but the general opinion seems to regard their deposits as of the Lower San Pedro age, or the lower Pleistocene.

At Lomita, an excavation has been made into one of these hills, its contents being ground up as fertilizer. The bulk of each layer is organic, foramnifera (chalk animals) and broken shells with occasional bones of large animals, Diatoms, where occurring have been dissolved by the calcareous shells of associated foraminifera.

The excavations now made (1922) have a depth of 55 feet, and extend for about the same distance into the hill. They show half an anticlinal with a strong dip to the west, the different strata quite narrow and crossed by four or five small faults of 2 to 5 feet slip each. So far as noted, there is no unconformability of strata, and no evidence of a "lost period."

In an informal report to the Torrance Lime and Fertilizer Company, by Professor Gilbert Ellis Bailey, thus defines the three sections shown in the pits:

1. Top, the level top of one of the lower terraces (of the Palos Verdes) or the second major terrace is covered by thin soil.

2. Immediately below the soil is a narrow band of marine gravels which was the beach when the base of the hill was lower than the present sea level. (Half a mile to the East are large sand dunes, formed in connection with this beach.)

3. Below the marine gravels of the terrace are the white marls of the Lower San Pedro, or Deadman's Island beds. (This section is divided into two parts, by its fossil remains although no obvious division occurs in the rocks. The content of each division is given below. Mr. G. Dallas Tanna of the California Academy of Sciences furnishes me the enclosed preliminary record of the content of the different layers.)

RESULTS OF PRELIMINARY EXAMINATION OF SEVEN SAMPLES OF SEDIMENTS FROM NEAR LOMITA

By G. DALLAS HANNA

All of these samples except No. 6 are very clearly marine sediments which have been laid down in fairly deep and very quiet water. The presence of great numbers of Foraminifera is an unworn condition and the mineral, glauconite, is almost positive proof of the origin of the deposits.

No. 1: This is a white, compact rock which consists exclusively of remains of Bryozoa, Foraminifera and Echinodermata, the first mentioned being the most abundant. The mass has been thoroughly impregnated with supersaturated mineral waters so that most of the fossils are coated more or less with calcite and the whole is loosely cemented together. Among the Foraminifera, **Polystomella crispa** (Linnæus) is the dominant species with **Rotalia soldanii** (Orbigny) very common. Both are long-ranging species geologically and widely distributed in modern seas. Mollusks are scarce and poorly preserved; evidently they and the shells of the echinoids decomposed and crumbled from the chemical action of the ground water. A few valves of **Ostracoda** were seen.

No. 2: This sample consist almost exclusively of beautifully preserved **Foraminifera, Globigerina bulloides** Orbigny being the most abundant form. Members of the genera **Textularia, Polystomella, Bulimina, Rotalia, Cristellaria,** and **Anomalina** are present. Echinoid spines are very common in some thin layers. A few sponge spicules were seen. Fragments of **Bryozoa** and mollusks are present in small numbers and the whole mass is loosely compacted into a light gray mass which readily disintegrates.

No. 3: This sample is very similar in texture and organic constituents to No. 2, but it is colored a light brown. Glauconite grains are abundantly disseminated throughout the mass.

No. 4: The sample submitted appears to consist exclusively of **Foraminifera,** echinoid spines and glauconite grains. The whole has been cemented into a firm mass by the deposition of minerals from supersaturated ground waters. The most abundant foraminifera is **Polystomella crispa.**

No. 5: Shells of mollusks have been thoroughly decomposed by mineral bearing waters and the whole is cemented into a firm white rock. Tests of **Foraminifera** are abundant and well preserved, although usually incrusted more or less with calcite. (These shells are largely of the small cockle. **Venericardia ventricosa**) (J.)

No. 6: This is a very fine-grained, greenish, soapy material which does not appear to contain any organisms at all. Diatoms and **Foraminifera** are absent. The material should receive the attention of a chemist or mineralogist.

No. 7: This is a brown, sandy sediment, consisting of very large qualities of glauconite, some coarse sand and the remains of decomposed **Foraminifera.** All are loosely cemented together. (In this deposit are many bones of whales badly abraded.) (J.)

All these samples except No. 6 are marine sediments without a doubt and were laid down in quiet and fairly deep water. No species of **Foraminifera** were seen which would indicate that the deposit is older than the Pliocene; on the other hand, my examination does not definitely prove it of that age. (G. D. H.)

In the lower beds are many teeth, referred provisionally to some species of Squalodont whale (**Scaldicetus**) not identifiable as to species from the teeth alone, according, to Dr. Oliver P. Hay and Dr. Remington Kellogg of the United States National Museum to whom they have been sent. In the upper beds are two elephant teeth, besides a fragment of tusk, and some broken bones. According to Professor Charles Stock of the University of California, these may belong either to **Elephas columbi** or **Elephas imperator**, the specific characters not ascertainable from single teeth. Numerous horse teeth, (**Equus occidentalis**) according to professors Stock, Hay and Kellog, occur along with badly worn bones. With these are also bones of a sea lion, **Eumetopias jubatus** of a dolphin **Eurhinodelphia** sp. and teeth of a seal, thought to be **Allodesmus kernensis** by Hay and Kellogg.

In a kitchen-midden on the surface of the hill are remains of abalone, the digit of a bear, a jaw of a deer, with arrow-heads and an Indian hatchet.

The following is a list of the fossil mollusks found in the Lomita beds, as identified by Mrs. Ida S. Oldroyd, Curator of Conchology, Stanford University.

I. Lower strata (presumably deep, quiet water).

GASTEROPODA

Glycimeris subobsoleta—Carpenter (No. 5.)
Kellettia kelletti—Forbes (9).
Antiplase perversa—Gabb (17).
Taranis strongi—Arnold (17x).
Pisamia fortis—Carpenter (2).
Fusinus species (22).
Natica reclusiana—Deshayes (14).
Polynices lewisi—Gould (13).
Buccinum species (23).
Argobuccinum oregonense—Redfield.
Conus species.
Dentalium pretiosum—Sowerby (24).

LAMELLIBRANCHIATA

Venericardia ventricosa—Gould (extremely abundant).
Pecten bellus—Concard (3).
Pecten hindsi—Carpenter (27).
Pecten diegensis—Dall (3x).
Pecten hastatus—Sowerby (2x).
Venus fordi—Yates.
Phacoides annulatus—Reeves (15).
Pododesmus macroschisma—Deshayes.
Protacardia centifilosa—Carpenter.
Crassatellites sp. indescr.

BRACHIOPODA

Terebratula sp.

II. Upper strata (presumably estuary deposits).

GASTEROPODA

Astræa inequale—Martier.
Astræa undosa—Wood (11).
Olivella biplicata—Sowerby (7).
Tegula multifilosa—Stearns.

LAMELLIBRANCHIATA

Hynnites giganteus—Gray (21).
Teredo (tubes) (F) (1) (8).
Phacoides californicus—Conrad (12, 16).
Saxidomus giganteus—Deshayes.
Saxidomus nuttalli—Conrad (19).

Key to Figures in Plate

PLATE I.

(All natural size)

a. Carcharocles rectus (lateral tooth), denticles lost.
b. Isurus hastalis (posterior side tooth)
c. Carcharodon rectus (extreme posterior tooth)
d. Carcharocles rectus
e. Carcharocles rectus
f. Carcharodon arnoldi
g. Isurus hastalis (front tooth)
h. Isurus hastalis (lateral tooth)
i. Carcharodon arnoldi (posterior tooth)
j. Carcharocles rectus

PLATE II.

(All natural size)

a. Carcharias clavatus
b. Gyrace occidentalis (upper posterior tooth, like type of **Triakis beali**)
c. Carcharhinus antiquus
d. Gyrace occidentalis
e. Gyrace occidentalis
f. Gyrace occidentalis
g. Notidanion boreale (type)
h. Carcharias clavatus
i. Gyrace occidentalis (extreme posterior tooth)
j. Carcharhinus antiquus
k. Carcharhinus antiquus (lower tooth)
l. Gyrace occidentalis (upper tooth)
m. Gyrace occidentalis (upper tooth)
n. Carcharias magdalenæ
o. Carcharias sanctæ-crucis
p. Cracharhinus antiquus
q. Gyrace occidentalis (lower tooth)
r. Carcharhinus magdalenæ
s. Carcharhinus magdalenæ
t. Xiphodolamia morricei (lower front tooth)
u. Hemipristis heteropleurus
w. Gyrace occidentalis (lower tooth)
x. Heptranchias andersoni (median tooth)
y. Heptranchias andersoni (side tooth)
z. Heptranchias andersoni (front tooth)
aa. Hemipristis heteropleurus (upper front tooth)
bb. Hemipristis heteropleurus (upper front tooth)
cc. Gyrace occidentalis
dd. Heptranchias andersoni (lower side tooth)
ee. Heptranchias andersoni (lower side tooth)

PLATE III.

a. Aetobatus smithii
b. Squatina lerichei
c., Squatina lerichei
d. Carcharias sanctæ-crucis
e. Carcharias sanctæ-crucis
f. Isurus sanctæ-claræ

g. Labial cartilage of Isurus hastalis
h. Aetobatus smithii
i. Squatina lerichei
j. Squalus serriculus
k. Carcharias sanctæ-crucis
l. Isurus sanctæ-claræ
m. Aetobatis aragonis
n. Aetobatus smithii
o. Lamna caurina (posterior tooth)
p. Aetobatis aragonis
p. Squalus serriculus
r. Squalus serriculus
s. Lamna caurina (posterior tooth)
t. Carcharias virgatulus
u. Carcharias virgatulus
v. Carcharias ornatus
w. Carcharias ornatus
x. Isurus hastalis (young)
y. Isurus hastalis
z. Aetobatis merriami
aa. Carcharhinus magdalenæ (type)
bb. Carcharhinus magdalenæ
cc. Isurus species (from Oregon)
dd. Carcharocles auriculatus (from England)

PLATE IV.

a. Xiphodolamia morricei
b. Xiphodolamia morricei
c. Echinorhinus blakei
d. Echinorhinus blakei (median tooth)
e. Xiphodolamia morricei
f. Aetobatus smithii (spine)
g. Isurus hastalis
h. Isurus hastalis
i. Aetobatus merriami (spine)
j. Gyropleurodus francisci (fin spine)
k. Isurus hastalis
l. Isurus hastalis

PLATE V.

a. Carcharodon branneri (side tooth)
b. Carcharodon riversi
c. Carcharias virgatulus
d. Isurus hastalis
e. Isurus hastalis
f. Isurus hastalis
g. Carcharodon purplei

PLATE VI.

a. Carcharias clavatus
b. Carcharodon purplei (type)
c. Carcharias lomitæ
d. Carcharhinus magdalenæ
e. Isurus sanctæ-claræ
f. Carcharodon branneri (type)
g. Carcharodon arnoldi
h. Xiphodolamia morricei (type)

i. Carcharias lomitæ (type)
j. Carcharodon arnoldi (type)
k. Carcharodon species (Florida)
l. Carcharodon arnoldi
m. Carcharodon mortoni (South Carolina)

PLATE VII.

Carcharodon leviathan (type and co-type)

PLATE VIII.

Carcharodon leviathan (Los Angeles)

PLATE IX.

a. b. d. Teeth of Squalodent whales (Scaldicetus species)
c. Equus occidentalis
e. Carcharodon branneri
h. j. k. Teeth of seals (allodesmus kernensis)
i. Digit of a bear.

PLATE X.

Teeth of Mammoth; **Elephas** species.

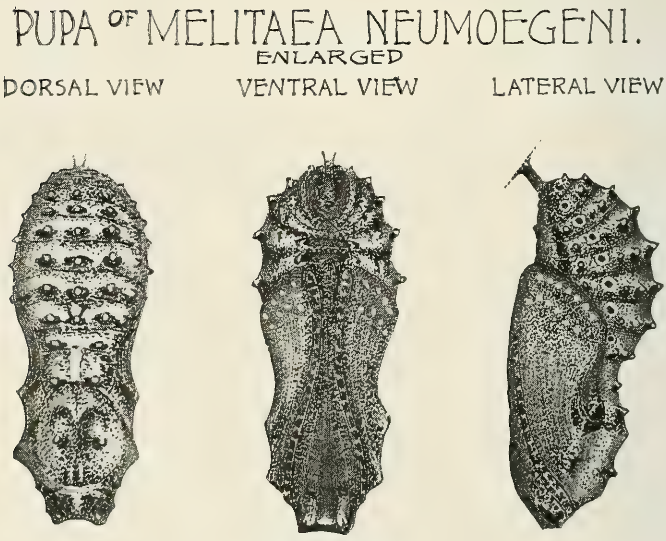


PLATE XV.

STUDIES IN PACIFIC COAST LEPIDOPTERA

—— DR. JOHN A. COMSTOCK ——

Early Stages of Melitæ neumoegeni, Skinner

(Illustrated by the Author)

On a recent collecting trip over the Mojave Desert, my wife and I were fortunate enough to observe the larvæ of **Melitæa neumoegeni,** skin feeding on **Aster tortifolius.**

Several specimens were secured, and two examples reared to maturity, the remainder being parasitized. The following notes were made of the larvæ and pupæ.

LARVA, LAST INSTAR.

HEAD: Glistening black, profusely covered with vibrissae.

BODY: Ground color black, sparsely sprinkled with grey dots. A lateral band of a lighter shade, due to the enlargement of the grey punctuate spots over this area, also a fine median dorsal black line, caused by the absence of these dots.

The body is profusely covered with numerous branching jet black spines, arranged in nine rows.

The median row contains nine of these, beginning at the 4th segment.

The next lateral two rows contain ten spines each, and extend from the second to the eleventh segments; the lateral row contains eleven spines, beginning at the first segment, all of which are well developed. The dorso-lateral row consists of numerous small spines. The anterior three are single, the fourth is compound, consisting of three, nearly united at their base; the remaining spines are paired on all segments except the terminal posterior which is single and minute. The total number of spines in this row is 17.

SPIRACLES: Black centers, annulated with grey.

TRUE LEGS: Shiny black.

PROLEGS: Dull black.

ABDOMEN: Brownish black.

LENGTH: 24 mm.

One larva was observed that measured 14 mm. in length having just complete a molt. We judged it to be in the beginning of the third instar, but were unable to carry it through. It was similar to the examples above noted except for lighter colored prolegs and spiracles lacking the annulation.

PUPA

(See Plate XV.)

GROUND COLOR: Black, profusely mottled with grey.

ANTENNAL SHEATHS: Black, annulated with fine grey lines.

HEAD REGION: Smooth, black; the eye case a glistening jet black.

WING CASES: Darker than other portions of body, slightly rugose near base, outer margins bearing two rows of minute, clearly defined, grey dots.

ABDOMINAL SEGMENTS: Grey predominates. The dorsal and lateral surfaces bearing papillae, arranged in rows corresponding to the larval spines. Most of these are tipped with orange, and are shaded anteriorly with black at their bases. The median dorsal row bears seven of these papillae, all orange tipped. The next lateral row contains ten, all orange tipped.

The second lateral row carries seven papillae, only the anterior three of which are orange. The third lateral row consists of four feably defined nodules, the anterior one only showing a trace of orange.

A poorly defined black stripe occurs on the ventro-lateral surface of abdomen, and a wider black band is situated in the median line of the ventral surface.

SPIRACLES: Black centers, grey annulated.

CREMASTER: Black with a slight brownish shading.

DIMENSIONS: Length, 15 mm.; greatest width, 6.5 mm.

The last larval molt occured on April 21st and emergence occurred on May 7th. (See Plate XV.)

PLATE XVI.

Dudleya Parva

PLATE XVII.

DUDLEYA PARVA

Rose & Davidson

(Revised description)

At first acaulescent, with 8 to 10 basal leaves; leaves fleshy, 5 to 7 cm. long, ovate-lanceolate to oblong-linear, 2.5 to 6 cm. long, convex beneath, concave above, acute; afterwards, at least in cultivation, producing long (2 to 3 dm. long) weak, trailing or procumbent stems with narrow, spreading leaves each ending in a few flowered raceme or sometimes in small panicles; leaves on flowering branch several, linear, spreading at right angles to the rachis, 1 to 2 cm. long; flower bud somewhat angled, pointed; sepals 3 to 5 mm. long, nearly equal, green, acutish; corolla about 10 mm. long, greenish yellow, with a very short tube; petals acute.

Collected by Mr. J. H. Bullard, on a clay bank on the Conejo Grade, Southern California, May, 1922 (No. 3535).

GILIA LINEATA n. sp.

Erect, slender annual, 2 dm. tall, glabrate in age, when young lightly tomentose on stem, more densely so on the stem leaves; basal leaves linear, acute, 2-3 cm. long, 1 mm. wide; stem leaves similar but smaller and a few in number; pedicels 8-10 mm. long; sepals tomentose, in fruit 3 mm. long, 1 mm. broad, the tips short, acute; corolla 10-12 mm. long, broadly funnelform, throat yellow, light blue above, lobes dark blue, rounded, 4 mm. long and 4 mm. broad; filaments equally inserted, 3 mm. long reaching the sinus; anthers blue.

No. 3570 type, collected by J. C. Marvin near Idlywild, Riverside Co., Cal., April, 1923.

This plant in general appearance resembles **G. leptalea** but in the latter the tomentum is absent, the leaves are longer and attenuate at base; the sepals are glabrous, narrower and with more attenuate tips; the flower is narrower with lanceolate lobes.

GILIA TRUNCATA n. sp.

Perennial from a woody base, 2-3 dm. tall; stems leafy with a scattered woolly pubescence throughout, more dense on the calyx; leaves simple, linear, 8-10 mm. long, 1 mm. broad; inflorescence racemose; pedicels 5 mm. long; calyx 6 mm. long its lobes triangular and very short; corolla scarlet, 2.5 cm. long, narrow funnelform, lobes 3 mm. wide and 6 mm. long, quadrate with 3 short teeth formed by the terminal points of the darker linear striæ that mark the petals; stamens unequally inserted, long exserted.

No. 3572 type. Collected by Messers, Payne and Kesslar near Jacumba, San Diego Co., April, 1923.

HASSEANTHUS KESSLERI n. sp.

Corm small, ovate; stems ascending, 7-8 cm. high; basal leaves about 6, small, fleshy obovate with a slender petiole, withering early; stem leaves sessile, ovate-lanceolate, very fleshy, 8-10 mm. long, 4 mm. wide and nearly as thick; upper leaves smaller and ovate; flower 10 mm. in width, nearly sessile, calyx lobes bluntly ovate, 2.5 mm. long; petals 6 mm. long, white with a pinkish median stripe, the color not changing in age; stamens equalling the petals; anthers at first yellow, dark brown in age; carpels 6 mm. long, stellately spreading.

No. 3495, type. Collected by Mrs. J. H. Bullard on a hard clay bank on the Conejo Grade, Ventura Co., May 1922.

ALLIUM BULLARDI n. sp.

Bulb without definite reticulation; stem terete, 2 dm. high; leaves stout, 2 or 3, concavo-convex, 7 mm. broad and nearly equalling the stem in length; pedicels 20 or more, 1.5-2 cm. long; petals thin, ovate, the outer 4 mm. wide, 7 mm. long, light pink with a slightly darker median stripe, inner petals slightly narrower; stamens nearly equalling the petals; filaments filiform; pistil undivided, 4-5 mm. long; pedicels declined in fruit; ovary with 6 conspicuous crests.

No. 3575, type. Collected by Mrs. J. H. Bullard near San Julian, San Diego Co., April 1923.

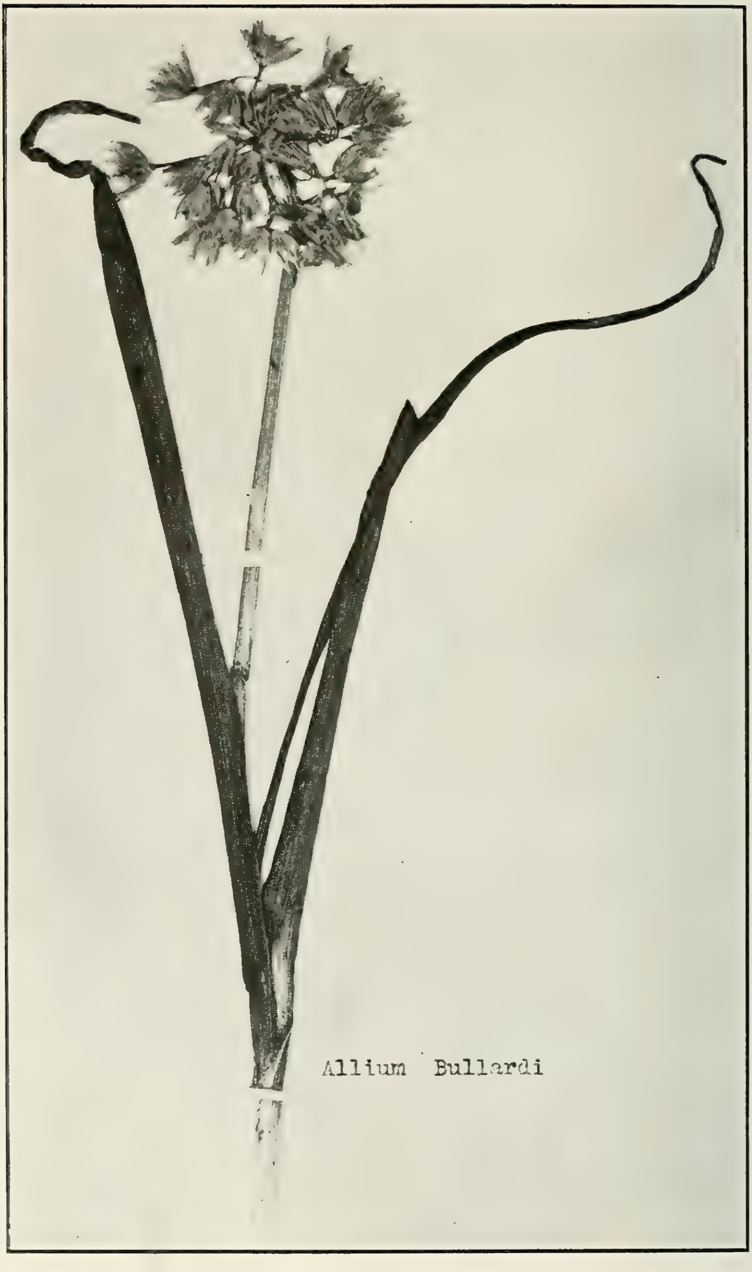
The broad leaves and filiform filaments readily identify this species.

PLATE XVIII.

Hasseanthus Kessleri

PLATE XIX.

PLATE XX.



BUTTERFLIES OF CALIFORNIA

DR. JOHN A. COMSTOCK

The Parnassians

(See Color Plate Frontispiece)

The various races and varieties of the **Clodius Parnassian** occurring in the state were dealt with in our last paper. There remain for consideration several forms of the **Smintheus Parnassian** before we pass on to the next family.

Typical **Smintheus** does not occur in California, but one or possibly two well defined varieties, and one aberration may safely be included in our list.

The races of **smintheus** as a whole may be distinguished from **clodius** by the fact that the wings are less transparent, particularly in the males. There is also a tendency for red spots to occur in the primaries, more markedly in the females.

BEHR'S PARNASSIAN (Parnassius smintheus behri, Edw.)

(Color Plate VI, Figures 1, 2, 3.)

This race occurs in the Central Sierras at suitable elevations. It is relatively smaller than other forms of **smintheus,** and one of its characteristic features is the tendency of the usual red spots to become yellow or orange. In comparison with the Baldur Parnassian, it is relatively rare. July and August are the months of its greatest frequency. Stonecrops constitute the larval foodplant.

WRIGHT'S ABERRANT PARNASSIAN (P. smintheus niger. W. G. Wright)

(Color Plate VI, Figure 4.)

This is an aberration of **Behr's Parnassian** in which the usual reddish or yellow spots are obsolete, and the dark markings reduced. So far it has been noted only in the male. Like all aberrant forms, it is rare.

THE LARGE PARNASSIAN (P. smintheus magnus, W. G. Wright)

(Color Plate VI, Figures 7, 8.)

This variety will very likely, be found in the higher ranges of our northern tier of counties, at high elevations. It closely resembles a Colorado form, **the Melanic Parnissan,** which is shown on Plate VI, figures 5 and 6 for purposes of comparison. Some of our early collectors recorded the latter species for Mts. Shasta and Bradley, but undoubtedly it will be found that their captures were **Parnassius magnus.** As with most alpine species, the Large Parnassian is on the wing only in mid-summer.

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"	19,	"	4.	October,	1920	.25
"	20,	"	1.	April,	1921	.25
"	20,	"	2.	August,	1921	.25
"	20,	"	3.	December,	1921	.25
"	21,	"	1.	March,	1922	.25
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Southern California Academy of Sciences, Southwest Museum
Los Angeles, California.

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BULLETIN OF THE
Southern California Academy of Sciences

LOS ANGELES, CALIFORNIA

Vol. XXIII January—February, 1924 Part I

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NOTES ON APHIDOPHAGOUS SYRPHIDÆ OF SOUTHERN CALIFORNIA.

— BY —

ROY E. CAMPBELL AND W. M. DAVIDSON*

U. S. Bureau of Entomology

While engaged in work on truck crop and deciduous fruit insects in Southern California the authors have had an opportunity to make many observations on predaceous insects among which the **Syrphidae** are of first rank, particularly in their relation to the aphid fauna. Although many observations have been made in all parts of Southern California, most of the data contained herein are from studies made in Los Angeles, Orange and Imperial Counties. While an attempt has been made to study all the species of aphid-feeding **Syrphidae**, it has been impossible to thoroughly cover all the territory, particularly the mountain and desert regions. The data have necessarily been largely confined to observations made on the **Syrphidae** which attack aphids on crops commercially grown.

While it may be said in general that in this region **Syrphids** are present the year around, most of the species are by far the most abundant in the spring and fall. They are most plentiful following heavy aphid infestations. There are a few species, however, which have been taken only in summer on and around plants which become infested with aphids only at this time of year.

The adults, known as flower flies, are on the wing almost any bright, sunny day, and visit the majority of honey-bearing flowers.

While some writers believe the **Diptera** to be virtually inconsequential in the pollination of flowers, there can be no doubt that the **Syrphidae** are of no small importance in this respect. Most of them possess sufficient vestiture of such a nature as to attach and carry pollen, and from the fact that they regularly visit the blossoms of fruit and shade trees, field and garden plants, as well as wild and cultivated flowers, it is apparent that they must be given credit for assisting in the pollination of these. The adults may also be observed flying about aphid-infested plants; both sexes for the purpose of feeding on the honeydew given off by the aphids; the females for oviposition.

The parent practically always seeks an infested plant, and lays her eggs among the aphids, or near them, so that food will be accessible when the young larvae hatch. The eggs are laid indiscriminately over the infested plant, usually with the long axis parallel to the stem or leaf upon which they are laid. (Figs. 1a, 1b.) They are laid singly by most species, but those of certain species of **Melanostoma*** and **Platychirus** are often ranked side by side, or end to end. It has been observed several times that on badly infested plants an egg may be laid directly on an aphid. This, however, is accidental, and because the aphids were so thickly disposed.

The eggs are all similar; chalky white, elongate, oval, microscopically sculptured on the surface.

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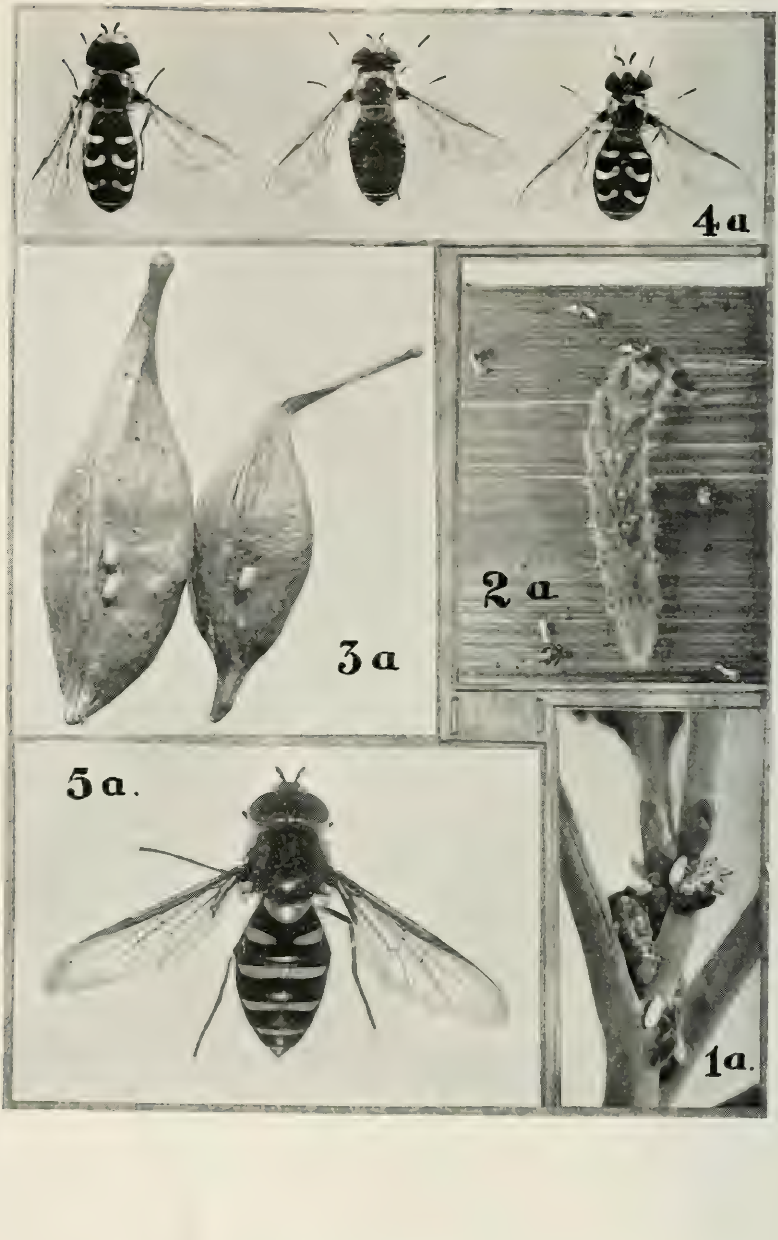
* The arrangement of the authors' names is alphabetical, and does not indicate seniority.

PLATE A.



The larvae are slug-like, some smooth, others wrinkled; some bear spines. (Figs. 1c, 2a, 2b, 2c.) They vary in color from pale greenish white or yellowish white to deep brown, green or salmon. When not in search of food they are sluggish and often lie concealed. Feeding larvae move actively, grasping the plant surface with the mouth hooklets, and drawing up the body thereby. The anterior end is used to feel their way, and also to seek food. They frequently strike out sidewise, and thus their range of action is increased. On touching an aphid the sharp mouth hooklets grasp it and the larvae sucks the juices, often raising the impaled aphid in the air. The process of devouring occupies from 45 seconds to 6 minutes, depending on the proportionate sizes of the larva and aphid. Larvae commonly attack all sizes of aphids, even very small larvae frequently being successful against large aphids. Large aphids attacked by small larvae sometimes escape with the derm abrased. The larva, after sucking out the juices, sometimes has difficulty in ridding itself of the aphid skin. If still hungry it immediately begins feeling about for another aphid, to be consumed in a like manner.

Curtailment or even absence of their food does not adversely affect the larvae, unless continued too long. Full-grown individuals not infrequently postponed pupation for weeks for no apparent reason. Larvae which had not completed their feeding endured starvation not more than a few days, but others, matured on a restricted food supply, generally developed into under-sized imagos. What effect this restricted food supply had on the reproduction of these small adults was not determined. Oviposition tests in general did not indicate a relationship between small size and weak reproductive power in the females. Experiments bearing upon restricted food of larvae are discussed below in connection with the species **Allograpta obliqua** Say.

The majority of the aphidophagous larvae feed during the day, but those of **Melanostoma**, at least, feed to a considerable extent, if not wholly, at night, at any rate under laboratory conditions, and the rarity of their collection in the field in the day time suggests that night is their normal feeding time.

Cannibalism is a trait to which most of the Syrphid larvae are addicted; this trait is much more commonly met with when larvae are caged in the insectary than when they are free, under natural conditions, when it is apparently practiced but rarely.

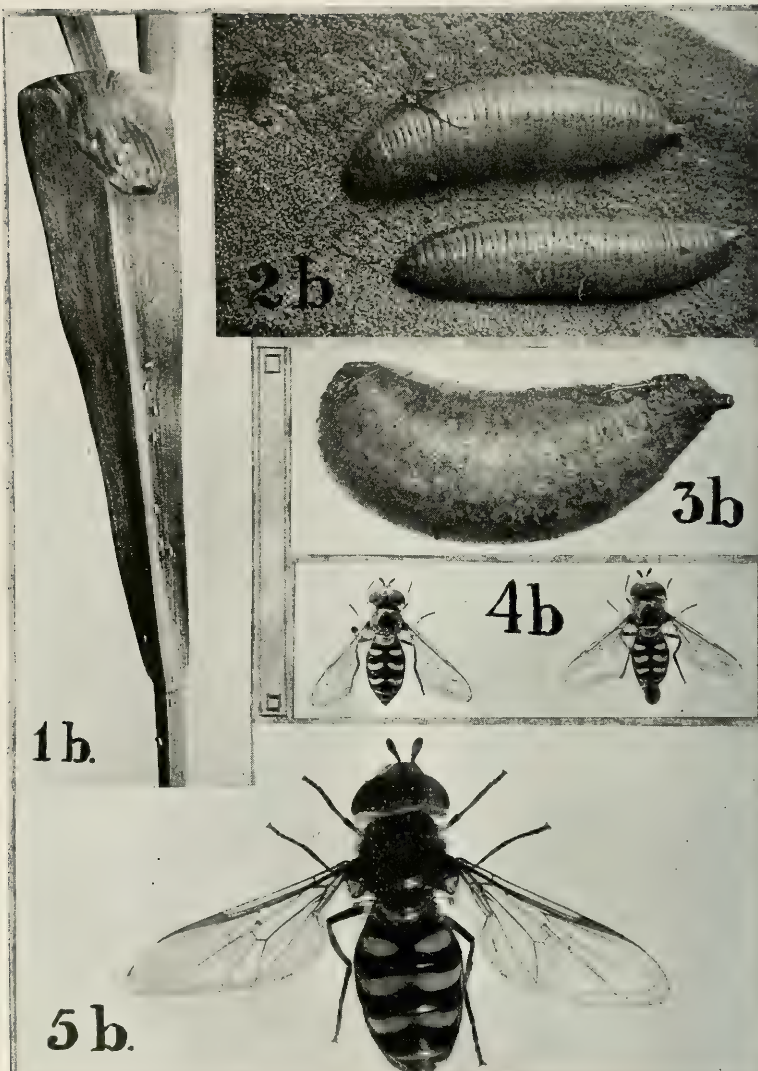
Ants occasionally carry off and kill Syrphid larvae, especially those of the species of **Allograpta.**

All the species of aphidophagous Syrphids are subject to internal parasitism, especially from members of the Bassini. Some parasitism is effected by **Pachyneuron** and **Bothriothorax.**

The eggs are laid, and the entire larval period is spent, on the plant. The larva may pupate on the plant, on the ground beneath the plant, beneath debris, etc., or in the ground. The larva usually finds some protected or hidden place, but may sometimes pupate on an exposed leaf.

Although flies and larvae of many of the species treated hereafter are to be found continuously the year around, in the case of others there is a period of several months in which the species hibernate and no active forms are seen. The writers are of opinion that only the pupal stage truly hibernates. In the case of those species which are visible throughout the year it should be said that during the period December 1 to March 1 reproduction is at the lowest ebb, and larvae are only met with occasionally in the field. To balance this low ebb of larval activity are large numbers of hibernating pupae which pass three or four months in a quiescent stage

PLATE B.



and are destined to transform in early spring. It is following this spring emergence that the great numbers of larvae are found.

RELATIONS TO ECONOMIC APHIDS

In the regions referred to in this paper the most abundant economic aphids are the following: **Aphis maidis** Fitch and **Toxoptera graminum** Rondani on grains and corn, **Illinoia pisi** Kalt. and **Aphis rumicis** Linne on legumes, **Brevicoryne brassicae** Linne and **B. pseudobrassicae** Davis on crucifers, **Aphis gossypii** Glover and **Macrosiphum cucurbitae** Thomas on cucurbits, **Myzus persicae** Sulz. on truck crops in general, **Aphis gossypii** and **Toxoptera aurantii** Koch on orange trees, **Chromaphis juglandicola** Kalt. on walnuts, **Macrosiphum rosae** Linne, **Rhopalosiphum nervatum** Gillette and **Myzus rosarum** Walker on roses.

It will be observed that the first nine species infest grains and truck crops, the next three fruit trees, and the last three, rose bushes.

The Syrphid **Catabomba pyrastri** Linne is the most partial to rose aphids. **Eupeodes volucris** O. S., **Syrphus nitens** Zett., **Allograpta obliqua** Say and **Sphaerophoria** have also been found not uncommonly on roses.

Chromaphis juglandicola in common with other tree-inhabiting aphids is especially attacked by **Allograpta** larvae, which pupate on the tree, but also to a small extent by **Eupeodes, Syrphus nitens, Catabomba** and **Sphaerophoria.**

Attacking the orange aphids the most prevalent forms are **Baccha clavata** Fabr., **Allograpta obliqua, Eupeodes** and **Catabomba.**

Eupeodes, Catabomba, Syrphus nitens, S. opinator O. S. and **Allograpta obliqua** occur on all the truck and grain aphids, but in somewhat varying abundance. Thus **Eupeodes** and the two Syrphi are the most commonly found on cruciferous aphids, **Catabomba** on the pea aphid (**I. pisi**), **Eupeodes** and **Allograpta** on the cucurbit aphids.

In Imperial County **Allograpta fracta** O. S. is by far the most common species on grain and corn attacked by **Aphis maidis** and **Toxoptera graminum**; the others, except **Eupeodes,** either being not present (**S. opinator**) or quite rare.

In Los Angeles and Orange Counties **A. obliqua** and **Eupeodes** are the most abundant species on grains.

Paragus tibialis Fallen and **Baccha clavata** are commonly found feeding only on **Aphis gossypii** and **A. rumicis,** apparently not attacking the other aphids to any appreciable extent.

Larvae of **Sphaerophoria** occur chiefly on non-economic hosts, but occasionally feed on the economic aphids.

Paragus bicolor Fabr. is so rarely met with that no favorite host can be reported.

Observations on the larvae of the species **Melanostoma** strongly indicate that they are aphidophagous and feed at night. However, their collection in the field is of the utmost rarity, and no favorite host can be reported for them. In confinement they will feed on many economic forms.

EUPEODES VOLUCRIS, O. S.

This is the species found most commonly the year around. Other species may exceed it in abundance at certain seasons, but they become scarce or are not found at other times, while Eupeodes can be taken frequently any month in the year. It is most abundant from January to May, is somewhat scarce in June, but becomes abundant again in July, and continues so the rest of the year. It may become scarce during a period of very cold, or of extended wet weather, but the above observations, as well as those which follow, are based on average conditions over a space of 6 years.

The species is very closely allied to Syrphus. The adult is one of the larger Syrphid flies, and measures from 7 to 10 mm. in length. The chief characters are as follows: Eyes bare, face yellowish white with a median black stripe, cheeks gray; thorax dark metallic green, scutellum luteous with black pile; abdomen oval, black, with 3 pairs of yellowish white spots not reaching the sides; the two posterior pairs lunate. Sixth segment of male unusually elongate and strongly asymmetrical bilaterally. (Fig. 4b.) Wings hyaline.

The eggs are chalk white, elliptical, .9x.35 mm., slightly narrower at Micropylar end. Elevations irregular in outline; elongate, 5 or 6 times as long as broad, thrice as long as high, connected by a fine network of whitish ridges.

The incubation period varies from 3 to 11 days. The newly-hatched larvae are light yellowish gray, narrow, with black hairs; mouth hooklets black, the posterior spiracles brownish circular pores. Each segment has a transverse row of hairs, each about half as long as the maximum width of the body.

The larvae eat voraciously, and become full-grown in from 11 to 33 days. Larvae reared in February averaged 27 days for development; others in midsummer averaged 14 days. The larvae have three instars, the third of which is usually slightly longer than the first, which in turn exceeds the second by a lessor period. The full grown larvae are 9 to 10 mm. long, and 2.5 to 3 mm. wide. The color varies in different specimens from a pale green with a yellowish tinge to a dirty salmon or greenish orange shade. A faint whitish median line shows, and also two whitish irregular dorsolateral stripes. The body is wrinkled, with the segments showing plainly. (Fig. 2a.) The segmental spines are conspicuous. On the integument drosum are a few scattering blotches made up of minute black spots. The posterior end of the body is somewhat flattened and truncate, anterior and tapering. Posterior spiracles light brown, very short, contiguous.

The number of aphids eaten by **Eupeodes** larvae varies according to the size and instar of the aphid. There is also a considerable diversity in the bulk of food consumed by them. Various feeding records showed the following for single larvae: 142 **Brevicoryne brassicae** (all stages); 239 **Myzus braggii** Gillette (stage iii); 341 **Macrosiphum rosae** (stages i-iv); 405 **Illinoia pisi** (stage i); 226 **Aphis gossypii** (stages iii-v); 252 **Myzus persicae** (stages ii-v); 186 **Aphis maidis** (stages i-iv); 230 (stages i-iv).

The fact that larvae will reach maturity and complete their transformation on a much fewer number of aphids was shown by one experiment in which only 93 **B. brassicae** were required. This was during March, when feeding and development were at a low ebb.

As is the case with other Syrphidae, pupation takes place in the hardened larval skin. The larvae pupate on the surface of the soil under debris, or occasionally an inch or less in the soil. The Eupeodes puparium varies from light to dark brown in color. Through the newly-formed shell or skin the larval viscera show, but these gradually histolyze, until, a few days before emergence, the eyes and yellow spots on the abdomen of the imago can be plainly seen. The puparium is 5.5 mm. to 6.5 mm. long by 3 to 3.5 mm. wide and 3 mm high. The dorsum is broadly convex, venter very slightly concave; anterior end bulbous; sides almost parallel for three-quarters of the length, then converge abruptly toward the posterior end. The posterior spiracular tubes are very short and inconspicuous, dark brown, contiguous.

The pupal period varies from 9 to 24 days. In captivity adults, fed on honey water, lived as long as 45 days. Probably they live longer under natural conditions.

Attempts to breed in confinement were mostly unsuccessful. On two occasions (August) a few eggs were secured from newly-hatched adults confined in wire field cages 2'x2'x1.5' containing beets infested with **Myzus persicae**. In these instances the females evidently deposited far short of their quota of ova, but this might have been due to the fact that they were denied access to flowers; although honey water and aphid secretions were available as food for them. A pre-oviposition period of about 6 days was indicated.

Copulation was observed in the laboratory on a few occasions and in each case the female at least was newly issued.

Oviposition records of gravid females collected as flies in the field, and which therefore might have deposited part of their quota of eggs previously, indicated a capacity of from 60 to 135 ova during individual oviposition periods of from 9 to 22 days. The eggs were distributed over this period very unevenly and deposited in an erratic fashion; a dozen or perhaps 30 on one day, and none for several days, and so on. All these flies were confined in wire screen cages fitted over potted plants infested with aphids, and they were daily fed diluted honey water. Of the total ova deposited approximately 75 per cent were fertile. The aphids used were four common vegetable pests; viz: **Brevicoryne brassicae, Aphis rumicis, Myzus persicae** and **Illinoia pisi.**

The sums of the maximum and minimum figures given above for the various stages, show that the period from egg to adult varies from 23 to 68 days, while the total length of life is from 39 to 119 days.

This indicates the possibility of a number of generations within a year. As a matter of fact, breeding and development is rapid when plenty of food is available, but slow when it is scarce. Development is also quite slow during the winter, when the larvae take a much longer time to reach maturity, and the pupal stage may be a month or more. Probably as many as six or seven generations occur annually.

Eupeodes larvae have been taken feeding on the following aphids: **Brevicoryne brassicae, B. pseudobrassicae** Davis, **Aphis gossypii, A. maidis, A. rumicis, Illinoia pisi, Macrosiphum rosae, Myzus persicae, M. braggii, Rhopalosiphum lactucae** Kalt and **Myzocallis californicus** Baker, var. **pallida** Davidson.

Diplazon laetatorius Fabr. and **Syrphoctonus maculifrons** Cresson, hymenopterous parasites, have been bred from the larvae of **Eupeodes volucris.**

To be continued in the March-April issue of the Bulletin.

DESCRIPTION OF A NEW FOSSIL SPECIES OF A CLAM OF THE GENUS *(CRASSATELLITES)*

— BY —

IDA S. OLDROYD
(Curator of Conchology, Stanford University)

Crassatellites lomitensis, Oldroyd, new species.

(Plate IX)

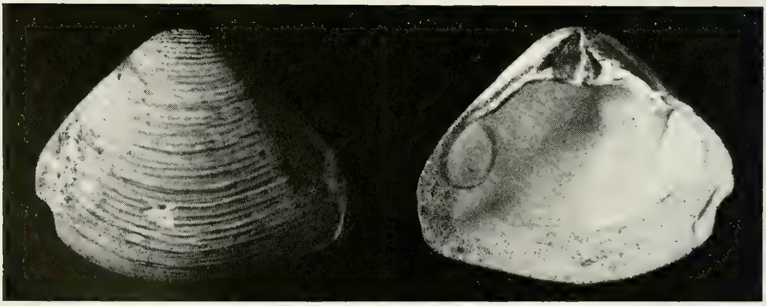
Shell of medium size, thick, solid, subtrigonal, about two-thirds as long as wide. Umbones small not prominent, strongly plicated. Anterior end broadly rounded, posterior bluntly truncated; the anterior portion of the lower edge rounded, poterior straight; umbonal ridge prominent, broad and rounded. Surface marked with small lines of growth. Inner margin crenulated. Both valves are complete and well preserved.

Length, 42; height, 34; breadth, 10mm.

The type in the Los Angeles Museum, collected by Mr. S. Maus Purple, in the Pleistocene beds near Lomita, Los Angeles County, California.

This species is nearest to the living form **Crassatellites, fluctuatus** Carpenter, and is very different in outline from **C. uvasana** from the Eocene near Fort Tejon.

PLATE C.



A NEW RACE OF THE LEAST BITTERN FROM THE PACIFIC COAST

BY DONALD R. DICKEY AND A. J. VAN ROSSEM

The writers have recently had occasion to compare a series of Least Bitterns (**Ixobrychus exilis**) from the Pacific Coast with birds from the Atlantic Coast. The latter have, in turn, been compared with such specimens from the Greater Antilles as were available to us, with the following results.

Even if the distinct erythrismal phase, which has until recently been known as '**neoxenus**'[1], be excluded from consideration, the Least Bittern is still found to exhibit striking color variation throughout its North American and West Indian range. Light and dark extremes occur in all areas where adequate collecting has been done. The extremes from one locality, however, can be matched in color with selected examples from almost any other area, irrespective of whether West Indian specimens be compared with birds from the Pacific Coast or with birds from intermediate stations[2]. Color variation therefore seems to be of purely individual rather than geographic significance. This generalization intentionally excepts Colombia, where the race, **Ixobrychus exilis bogotensis**[3], apparently distinguished by color as well as by size, seems to form an exception to the rule of the species.

In the matter of size, however, there is marked geographic variation in specimens from the Pacific Coast on one hand, and birds from the Atlantic Coast and the West Indies, on the other. This variation seems sufficient to warrant the subspecific recognition of the western bird, which is here described as follows:

Ixobrychus exilis hesperis, new subspecies

Western Least Bittern

Type: Male adult; no. K 349, Collection of Donald R. Dickey; Buena Vista Lake, Kern County, California; July 2, 1922; collected by A. J. van Rossem; original no. 7028.

Diagnosis: Similar in color to the typical phase of **Ixobrychus exilis exilis** of eastern North America and the West Indies, but larger in all dimensions, particularly in wing, tail, and bill; tarsi and feet not only longer but heavier.

Range: Western United States and Lower California.

MEASUREMENTS

MALES

	Wing			Tail			Exposed Culmen			Tarsus			Toe		
	Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.
brychus exilis exilis	106.	119.	114.	38.0	47.5	40.9	41.0	46.3	44.5	37.0	42.7	39.8	34.7	39.2	37.0
brychus exilis hesperis	120.	131.	126.	42.5	47.0	45.6	44.7	52.2	48.2	38.5	43.8	41.8	38.0	42.5	39.7
				FEMALES											
brychus exilis exilis	109.	117.	112.	37.5	42.5	40.2	43.0	47.3	44.8	37.5	42.0	39.0	34.3	39.5	36.5
brychus exilis hesperis	114.	129.	125.	41.5	45.5	43.8	44.3	50.2	46.9	39.4	42.7	41.2	37.5	40.3	39.1

Careful analysis of the measurements of the limited number of birds at our disposal from various islands of the Greater Antilles fails to disclose any appreciable or constant difference between these specimens, and birds from the eastern United States. The two adult birds we have examined from Jamaica have longer and more slender bills than do birds from the eastern mainland and from the other islands. It may well be that further material from Jamaica would tend to emphasize what now seems merely a tendency, and to indicate the propriety of reinstating the name '**neoxenus**' as applicable to the birds of the eastern United States. However, the material from Jamaica is so scanty and the difference so slight that for the present we prefer to consider all specimens from the Atlantic Coast and the Greater Antilles as broadly typical of **exilis**. In the above table, therefore, the measurements given for **exilis** are based on a composite series from Jamaica (2), Haiti (7), Porto Rico (4), and eastern United States (14). The measurements of **hesperis** are based on birds from Oregon (6), California (19), and Lower California (2). Birds from the Middle West are purposely omitted, as intermediate between **exilis** and **hesperis**. Only adult specimens were employed in our comparisons.

Acknowledgments: Our sincere thanks are due the following institutions and individuals for the privilege of examining eastern specimens: California University, Museum of Vertebrate Zoology (Dr. J. Grinnell), Harvard University, Museum of Comparative Zoology (Mr. Outram Bangs), Los Angeles Museum of History, Science and Art (Mr. L. E. Wyman), Dr. Loye H. Miller, U. S. National Museum (Dr. C. W. Richmond), and U. S. Bureau of Biological Survey (Dr. E. W. Nelson).

Pasadena, California, December 14, 1923.

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[1]Auk, 32, 1915, pp. 481-484; Auk, 40, 1923, p. 524.

[2]The Porto Rican series averages paler, with less buffy suffusion, than any other series we have examined, but even its extreme individuals can be matched by certain birds from Illinois, California, and Lower California.

[3]Amer. Mus. Nat. Hist., Bull., 36, 1917, pp. 231-232.

AN ALBINO FORM OF ZAUSCHNERIA

GEORGE L. MOXLEY.

On November 18th, 1923, Mr. F. M. Fultz collected a most interesting form of **Zauschneria** in Millard's Canyon. The plant is low, being not more than 3 dm. high. The foliage closely resembles that of typical **Z. microphylla** in that it is gray with a closely appressed tomentum, the leaves being linear and very narrow and perhaps a bit shorter than those of normal **microphylla**. The chief distinction of this plant is in the color of the flowers, which are pure white, the calyx lobes only showing a creamy tint. Only one plant was seen but Mr. Fultz made careful note of its location so that it may be observed next year to see if its albino color is permanent. This is the first albino form of **Zauschneria** that has ever been brought to my attention and, I believe, the first so far recorded.

STUDIES IN PACIFIC COAST LEPIDOPTERA.

DR. JOHN A. COMSTOCK

THE REDISCOVERY OF A "LOST SPECIES."

All of those who work in the Biologic Sciences must know of the great pleasure that comes from the discovery of a new species. Second only to this is the thrill that may be derived from the rediscovery of a species originally recorded by some pioneer naturalist and then lost to science through the subsequent years.

We have a number of species of the **Lepidoptera** (butterflies and moths) occurring in the Southwest, which fall within the general understanding of the term "lost species." Strange to say, several of these occur in the genus **Cercyonis.** Two of these are considered to be extinct. The first, namely **Cercyonis sthenele,** formerly occurred in the region of San Francisco. Its territory was extremely limited, and the destruction wrought to native vegetation so modified its environment as to cause its disappearance.

A second species, **Cercyonis behri,** reported by Grinnell from the Mt. Tamalpais districts, seems also to have disappeared. The types and nearly all of the specimens extant were in the Museum of the Academy of Sciences in San Francisco, and helped to feed the flames that followed in the wake of the earthquake.

A third species, collected by one of the naturalists of the Wheeler Survey and named by Edwards after Lieutenant Wheeler, was taken somewhere in the district between the Cascades and the Rocky Mountains. Some of these specimens were later submitted to Strecker and re-described as **hoffmani.** This latter series were recorded from the Owens Lake district, but the California record is questionable. The regions about Owens Lake have been diligently collected by several Lepidopterists, but without avail.

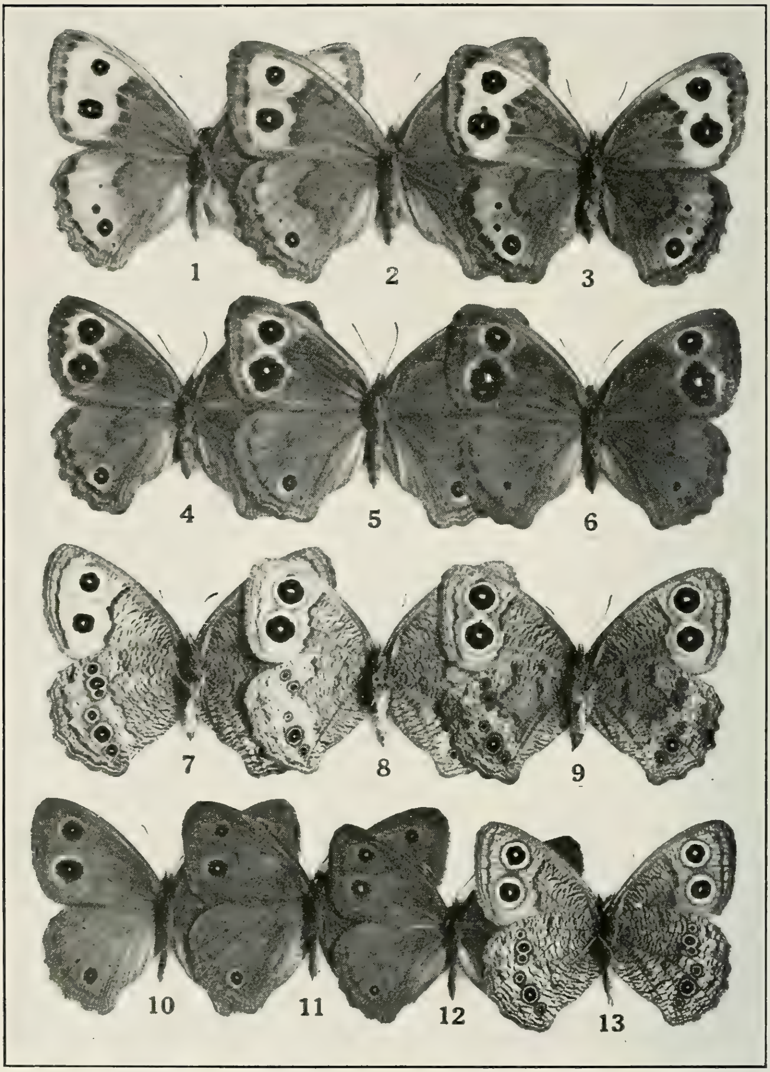
The fourth species was described by W. G. Wright, who named it after the pioneer naturalist, Frank Stephens. It was originally recorded from northeastern California. The species has long remained an enigma to entomologists. Several expeditions have been sent into the territory for the special purpose of securing it, but without success. Fortunately, Mr. Stephens is still with us, and it was therefore possible to secure more specific information in regard to the type locality.

For some years past I have been laying plans for unravelling the mysteries connected with this so-called lost species. This past summer my wife and I made a collecting trip through Modoc county for the specific purpose of securing **Cercyonis stevensi.** We had previously been in communication with Mr. Stephens and with other naturalists who had talked with the discoverer regarding the type locality and time of occurrence. The information thus secured was somewhat conflicting. Mr. Stephens wrote that he "caught the types of **Satyrus stevensi** in Mono county, California, a few miles from the Nevada line, and some thirty miles south of the Oregon line." It is obvious that he referred to Modoc county and not to Mono.

W. S. Wright reported a conversation with Mr. Stephens, in which he recorded the locality as "several miles north of Alturas in the lava fields," where he reported capturing the species "on the late afternoon of August 7th."

PLATE D.

Cercyonis stephensi



All figures slightly reduced.

Mr. W. G. Wright, in his "Butterflies of the West Coast," states that "the country whence this species comes, was at one time volcanic, and now is a sort of Dead Sea region of wide, sandy wastes, draining into dead salt lakes and marshes that have no outlets."

Those who are familiar with this region of Modoc county will readily see that three distinct environments are thus given; first the lava beds, next the salt lake deserts, and third the marshy lands immediately north of Alturas.

We made it our objective during the trip this past summer to thoroughly explore the districts north and east of Alturas, including not only the lava beds, dry salt lakes, and marshy valley lands, but also the mountain ranges of the territory. Upon investigation the lava beds were found to contain only one small species of **Cercyonis,** referable to the **sylvestris** group. The mountain ranges also yielded the same species. There are no extensive salt flats immediately north of Alturas, but in the valley to the northeast of this district extending from Fort Bidwell south to the Lassen county line, there are vast areas of these forbidding desert flats. No **Cercyonis** were found to occur immediately on the salt levels, but in the marshy territories surrounding these, and also in the valley lands surrounding Goose Lake we found a large species occurring quite plentifully. They seemed to be the object of our search.

The first point which yielded the species was a marshy meadow incorporated in a ranch some ten miles out of Alturas on the Lakeview road. A number of these marshy areas occur along the southern and eastern edge of Goose Lake, and also in the regions about Fort Bidwell. In all of them we found this species of **Cercyonis.**

A point which greatly puzzled us was the fact that only the most extreme examples of the light colored females agreed with Mr. Wright's figure of **Cercyonis stephensi.** We also found that none of the examples taken exactly agreed with the figure of the under side of the primaries, as shown on his plate 23, figure 249c. It became quite obvious to us that Wright had figured only females, but in order to clear the matter we determined to visit the Academy of Natural Sciences in San Francisco for the purpose of examining the types. Through the courtesy of Mr. Van Duzee this was made possible.

We found, as we had suspected, that Wright's figure 249 is a female, and not a male, as he states. Furthermore, his figure c, purporting to show the under side of the species is very misleading. The proximal wing of the primaries has been lost, and the figure thus shows the upper side of the primary and the under side of the secondary. Our series of captures demonstrates the fact that this light colored female is an extreme variety, and that the more typical female contains much less of the yellow submarginal banding. Some examples, in fact, show almost none, as will be seen by reference to our plates.

Through a careful study of the literature and of series in the collection of the Southwest Museum we find that the species is none other than **Satyrus gabbii.** The typical male of the latter species is shown on Wright's plate 23, figure 250. The specimen secured was taken in the same territory, and at the same time by Mr. Stephens. It seems strange that Wright did not recognize this as the male of his so-called new species. It is perhaps permissable to retain the name **stephensi** as applied to an extremely light form of the female of **Cercyonis gabbii.** The accompanying plate will show the range of variation occurring in the female of the species and in addition a small series of males.

We have thus managed to find one of the lost California **Satyrids** and in finding it have determined that it is nothing more than an extreme variation of a previously recorded species.

Our plate figures thirteen examples of this interesting species. They are arranged to illustrate the range of variation in both sexes. Figure 1 is the light form which Wright has called **Stephensi.** We compared it with the types and find that it agrees in every particular except for the slight extension of the gray ground color toward the anal angle. Wright's specimens are a shade lighter than the normal freshly emerged forms due to the amount of fading they had undergone before his plates were made. (They were in his cabinet for eleven years, exposed to the light, before being figured.) This example was taken in copulation with a dark male.

Figure 6 is an extremely dark female. The intermediate examples are chosen from a long series which represents every gradation from the light, yellow bordered form to the dark variety with heavy ocelli. Figures 7 to 9 represent the under surfaces of three females, chosen to demonstrate the light, intermediate and dark forms.

Figures 10 to 12 show the upper surfaces of three males, and Figure 13 represents the under surface of the same sex.

In order to determine more specifically the **exact** type locality of C. Stephensi I again wrote Mr. Frank Stephens, and received the following reply:

"I netted half a dozen Satyrus stephensi on the 10th of August, 1894, in the valley some miles south of the southernmost Alkali Lake, in Modoc Co. We have been packing preparatory to moving and my notes are not available so I can't give the exact locality, but as I remember it the place was well covered with vegetation. So far as I know no other specimens have been taken since until you found them. Those I took were worn, and probably it was near the end of their season."

ERIOGONUM CROCATUM n. sp.

A. DAVIDSON, M. D.

Perennial, 2 dm. high, semi-decumbent from a woody base; leaves numerous, scattered, suborbicular, 2 cm. broad, 2.5 cm. long, shortly decurrent on the 1 cm. long petiole; whole plant white tomentose, the under surface of the leaf whiter than the upper; flowering stem branching above at right angles to the stem the 3 subtending bracts triangular, acute, 8 mm. long, secondary bracts similar but smaller; involucres very woolly; pedicels 3 mm. long; perianth campanulate, open, upright, its segments lanceolate, 2 mm. long, 1 mm. wide, light yellow with a darker median stripe; pedicels declined in fruit; mature fruit unknown.

Abundant and widespread in the rocky grounds west of the Conejo grade, Ventura County. June, 1923. No. 3576, type. Collected by Robert Kessler.

In general appearance this plant might easily be mistaken for **E. umbellatum** Torr., but it differs in the foliage, flowering habit and most markedly in the narrow lanceolate perianth segments. Those in **E. umbellatum** being conspicuously obovate.

PLATE E.

BUTTERFLIES OF CALIFORNIA.

(Continued)

DR. JOHN A COMSTOCK

THE WHITES AND ALLIES.

Family PIERIDAE.

GENUS NEOPHASIA, Behr.

Only two species of this interesting Genus of butterflies occur within the confines of the United States. One of these is found in California, and the other, occurring in the neighboring state of Arizona, may eventually work its way within our borders.

THE PINE WHITE. Neophasia menapia, Felder. (Plate VII, Figures 1, 2, 3 and 6) is found along the Sierras in the yellow pine belt. It has not been recorded for the Coast ranges, and the southernmost point this far reported is the Tehachapi Range. It may be found in abundance, at moderate to high elevations, flitting about the conifers. One must look for it during the month of August, though occasional captures are recorded for July, and belated specimens may be seen in September. It may also have an early spring brood.

The Pine White is an aggravating butterfly to capture as it spends most of its time circling about the higher branches of the pines, only occasionally deigning to descend for a hasty sip of nectar from the scant blossoms of the forest floor. It may be tricked, however, into coming within the range of a net by means of a decoy. The best method is to pin a dead specimen of Neophasia on the tip of a low branch of a pine, within easy reach of the net, in as conspicuous a situation as possible. The high flyers will swoop down for inspection. If the decoy is a female they will remain for some time. Only the males may be lured in this manner. The females are shy creatures, always rare, and seldom on the wing.

The caterpillars feed on the needles of various conifers, such as the Jeffrey pine, yellow pine, beach pine and common balsam fir. They sometimes work great damage in the forests. When the larvae are ready to pupate they descend on silken threads, and form their chrysalids on the scant growth at the foot of the pine trees.

One variety, **Suffusa,** has been named by Stretch from examples taken in Washington, which is characterized by a relatively greater amount of black on the under side of secondaries in the female, and a tendency for the red markings to disappear. There is much variation in this regard, even in examples taken in a single locality. The name, therefore, seems hardly worthy of retention.

The author has distinguished an interesting aberration, the BLACK-RIBBED PINE WHITE, **N. nigracosta,** which is shown on plate VII, figures 4 and 7. The darkening of the costal area in this variety seems to suggest an atavistic tendency toward a possible common ancestor of our two species, **N. menapia** and **N. terlooti.**

GENUS PIERIS. Schrank.

BECKERS' WHITE. Pieris beckeri, Edw. (Plate VII, Figures 5, 8, 10.) confines itself mainly to the desert side of the Sierras throughout all of the eastern counties of the state. It may also be found in the higher mountain passes, and, occasionally, it wanders down the canyons which open on the coastal plains. In favored seasons it may be seen in large numbers on the high desert plateaus. The writer found it in great abundance in the Tehachapi Pass in July.

It is probably single brooded at high elevations, but undoubtedly has two or more broods throughout the greater part of its range. Records of its capture extend from April through to August. The types were taken at Virginia City, Nevada.

Bladder pod (Isomeris arborea) and other cruciferous plants constitute the larval food plant.

THE CALIFORNIA WHITE. Pieris sisymbrii, Bdv. (Plate VII, Figures 11, 12 and 13.) This interesting little species is not a common one with us, although in some of the arid states to the east it has been reported in great abundance. One must look for it at high elevations, preferably in the spring months. Occasionally it is taken as late as mid-summer. Like Beckers' white it does not occur in the coast ranges. Its territory does not extend south of Los Angeles County.

The larvae feed on members of the mustard family.

A form of the female is occasionally met with at high elevations, which is suffused with yellow. We show an example on plate VII, figure 9. This variety was called **flava** by Edwards in his Butterflies of North America. He may have used the term merely as an adjective, but as the name was preempted for the yellow form of **napi,** it is improper to apply it. We therefore propose the name **flavitincta,** and designate it as follows, establishing our specimen as the type.

Pieris flavitincta var. nov.

Upper side, primaries; ground color lemon yellow, nervules finely dusted with grey; costal margin heavily sprinkled with grey scales,

this shading widest at the base and narrowing toward the apex. The outer margin contains six grey bars which are related to the ends of the nervules, separated by lemon yellow areas of about equal width. This alternate grey and yellow barring is extended outwardly onto the fringes. Inner margin heavily shaded with grey. An interrupted irregular black line follows about the center of the limbal area, and is incomplete as it approaches the inner margin, and also between the first and second median nervules and the third meridian nervule and lower radial vein. A black quadrangular spot also occurs at the outer end of the cell. Basal area heavily clouded with grey scales.

Secondaries; ground color lemon yellow, outer margin barred much as in the primaries, but the grey scales less abundant. Internal to the grey bars is a line of sagittiform spots, centering on the nervules, their apices pointing outwardly. Nervules finely powdered with grey, more heavily defined toward the basal area. Fringes yellow.

Under side, primaries; ground color white, nervules lightly margined with grey and yellow scales interspersed, the grey predominating in the basal area and the yellow in the limbal. The bars and spots of the upper side are only faintly reproduced, those on the outer margin being more clearly defined than the others. A delicate yellow suffusion occurs along the outer margin. Basal area not heavily shaded as on upper surface.

Secondaries; ground color white, nervules yellow, margined with grey, giving the wing an evenly barred appearance. Sagittiform spots clearly defined except on internal and submedian veins. Outer margin delicately suffused with yellow.

Thorax; blackish grey above, white with grey scales below. Abdomen; blackish grey above, yellow below. Antennae, brownish black, tipped with yellow.

From the above description it will be noted that this form is practically a typical female of **Pieris sisymbrii** except for the lemon yellow suffusion of the upper surface. The specimen before us is perhaps a little more heavily marked than examples taken in California due to its boreal habitat. Edwards' figure shows less of the grey sprinkling.

Type locality. It is unfortunate that we possess no California examples from which to draw our description. The example before us was captured by C. Garret, on April 30th, 1911, at Cranbrook, British Columbia. So far as we know this yellow form occurs only in the female.

This article on the Pierids or Whites to be continued in the March-April issue of the Bulletin.

THE PENSTEMONS OF SOUTHERN CALIFORNIA.

PHILIP A. MUNZ* AND IVAN M. JOHNSTON.†

INTRODUCTION

The present paper represents an attempt at summarizing what is known regarding the classification and the distribution of the penstemons of Southern California. A particular effort has been made to present original data. Many field observaions on the color, corolla-shape, and habit of growth have been incorporated into the paper with notes on range and habitat. While working on our local penstemons, we have studied most of the important public and private California herbaria, as well as the material of the genus in the Gray Herbarium. Except in the case of a few rare species, however, no attempt has been made to cite all the material examined from Southern California, usually only those specimens being mentioned which geographically set the outposts for the species or those which furnish the basis for such statements as might possibly be challenged. The literature on our subject has been carefully reviewed and the more important references freely given. Reports regarding the occurrence of species have been considered both in admitting species to our accepted list and in giving distribution, but such reports, when unverified by our personal study of specimens are distinguished from verified statements of range by indicating those of the latter sort by the exclamation sign. Our use of the term "Southern California" and our conception of life-zones within this area have been defined in a previous paper (Amer. Fern Jour. 12:69. 1923).

We wish to express our appreciation to Miss Alice Eastwood, Mrs. Roxana Ferris, Prof. Marcus E. Jones, Mr. S. B. Parish, and Mr. F. W. Peirson for data regarding certain specimens, and for other kindnesses. The herbaria consulted in preparing this paper are herewith listed, together with the abbreviations used in citing specimens in these herbaria:

Baker Herbarium of Pomona College (BP),
Herbarium of California Academy of Sciences (CA),
Herbarium of Dr. A. Davidson,
Dudley Herbarium of Stanford University (DS),
Gray Herbarium of Harvard University (GH),
Herbarium of F. W. Peirson,

and the material that was available in the

Herbarium of the University of California (UC).

To those that have kindly permitted use of these collections, we acknowledge our indebtedness.

The genus **Penstemon** (for spelling cf. Pennell, Contr. U. S. Nat. Herb. **20**: 325. 1920) is one of especial interest in our region. Its species enter into most of the floral elements of North America, and serve as an excellent illustration as to which of these elements have contributed to the Southern California flora:

(1) Species practically endemic to Southern California:

(a) Lowlands: **antirrhinoides, cordifolius, spectabilis, heterophyllus** var. **australis.**

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*Pomona College, Claremont, California.
†Gray Herbarium, Harvard University.

(b) Mountains: **caesius, labrosus, Palmeri** var. **Grinnellii, Rothrockii** var. **jacintensis, ternatus** and var. **septentrionalis.**

(c) Deserts: **calcareus, Clevelandi** and vars. **connatus** and **Stephensi, fruticiformis** and var. **incertus, linarioides** var. **californicus**, and **Munzii.**

(2) Species entering our area from the deserts of Utah, Nevada and Arizona:
albomarginatus, Eatoni var. **undosus, Palmeri, pseudospectabilis, ambiguus** var. **Thurberi, subulatus, antirrhinoides** var. **microphyllus.**

(3) Species extending into our area from Middle California:
(a) Lowlands: **centranthifolius, heterophyllus.**
(b) Mountains: **breviflorus, laetus, speciosus** var. **piliferus.**

Our most widely ranging species is **P. Bridgesii**, which occurs in the mountains from Southwestern Colorado and Northern Arizona to Middle and Southern California. The most northerly ranging one is **P. speciosus** var. **piliferus**, which gets into Southern Oregon. Our most southerly ranging species is probably **P. Palmeri**, which occurs as far south as 29° latitude in Lower California. **P. cordatus** is the only species on the Channel Islands.

KEY TO SOUTHERN CALIFORNIA SPECIES OF PENSTEMON.

1. **Corolla scarlet.**

A. Stem leaves evidently petiolate, or linear with tapering bases; corolla deeply lobed; lower lobes linear, usually reflexed.

B. Sterile filament densely bearded; shrubs; leaves usually serrate; foothills.

C. Leaves opposite, ovate to ovate-lanceolate, base cordate or rounded; thyrse deltoid with divaricate or reflexed branches; stems not glaucous, scandent...4. **P. cordifolius**

CC. Leaves ternate, narrowly lanceolate, base cuneate; thyrse oblong-cuneate with ascending branches; stems very glaucous, usually self-supporting.

a. Calyces and pedicels glabrous ....5a. **P. ternatus.**

aa. Calyces and pedicels glandular-pubescent.........
..............5b. **P. ternatus** var. **septentrionalis.**

BB. Sterile filament glabrous; herbaceous perennials with at most a woody caudex; leaves usually entire; montane.

C. Pedicels and calyces glandular-pubescent; branches of thyrse spreading; corolla 2-3 cm. long, lower lobes 6-7 mm. long; anther sacs parallel, opening at proximal ends, slits confluent....................................21. **P. Bridgesii.**

CC. Pedicels and calyces glabrous; branches of thyrse strict; corolla 3-4 cm. long, lower lobes 12-16 mm. long; anther-sacs strongly divergent, opening at distal ends, the slits not confluent...............................6. **P. labrosus.**

AA. Stem leaves (at least the upper ones) with rounded or subclasping sessile bases; corolla-lobes not conspicuously long, oblong or ovate, reflexed only in **P. Munzii.**

B. Herbage glaucous; anther-sacs about 1 mm. long, dehiscent by a continuous slit extending across their contiguous parts and down the length of each sac; corolla subtubular, 4-6 mm. broad, obscurely bilabiate, longest lobe at most about 2½ mm. long.

C. Upper stem leaves ovate to lanceolate, many of them as long as or longer than the internodes; coastal slopes to edge of desert..............................9. **P. centranthifolius.**

CC. Upper stem leaves subulate and grass-like, mostly shorter than the internodes; eastern part of Mohave Desert...10. **P. subulatus.**

BB. Herbage green; anther-sacs about 2 mm. long, each with a slit extending from their distal ends for about 2/3 their length; corolla subcylindrical or narrowly funnelform, 5 to 8 mm. broad, more noticeably bilabiate, longest lobe 3-7 mm. long.

C. Corolla 20 mm. long, upper lobes straight, lower lobes reflexed, shape of corolla subcylindrical........7. **P. Munzii.**

CC. Corolla 25-32 mm. long, lobes all straight, corolla narrowly funnelform....................8. **P. Eatoni** var. **undosus.**

2. Corolla white or yellow to blue or purple, but never scarlet.

A. Anther-sacs with short slits which are confluent over proximal end of sacs, parallel or nearly so.

B. Blade of lower leaves ovate or suborbicular, 11-15 mm. broad, abruptly contracted to a narrow petiole 1-2 cm. long; leaves glaucous, subcoriaceous; corolla subtubular, 16-20 mm. long, 5-6 mm. broad; lobes short, 2-3 mm. long, scarcely spreading..................................22. **P. caesius.**

BB. Blades of lower leaves spatulate to linear, 2-13 mm. broad, gradually tapering to a short petiole; leaves green, herbaceous; corolla with inflated throat, 25-30 mm. long, 8-11 mm. broad; lobes well developed, 2-5 mm. long, usually spreading.

C. Leaves 4-10 mm. broad, dull with a short coarse pubescence; inflorescence with evidently spreading branches, clearly thyrsoid, very open, glandular-pubescent....24. **P. laetus.**

CC. Leaves 1.5-4 mm. broad, glabrate or glabrous; inflorescence with short, strict branches, suggesting a spicate condition, narrow, glabrate or merely puberulent.

a. Plant glabrous, mainly northern..23a. **P. heterophyllus.**

aa. Plant puberulent, mainly southern.............................23b. **P. heterophyllus** var. **australis.**

AA. Anther-sacs opening along their entire length, the slits usually confluent, sacs divaricate to spreading, not parallel.

B. Corolla-lobes longer than the tube; corolla excessively gaping.

C. Stem glaucous; leaves denticulate, 1-3 cm. long, 4-7 mm. broad; sterile filament naked; corolla about 5 mm. broad, flesh-colored or yellowish; plants forming bushy clumps 1-2 m. high with erect virgate branches......1. **P. breviflorus.**

CC. Stems not glaucous; leaves generally entire, 1-1.5 cm. long, 2-8 mm. broad; sterile filament densely bearded; corolla about 1 cm. broad, yellow; a large bushy shrub about 2 m. high with much branched spreading stems.

a. Twigs glabrate or puberulent, sepals ovate, obtuse; coastal ....2a. **P. antirrhinoides.**

aa. Twigs cinereous; sepals tend to be long-acuminate; desert....2b. **P. antirrhinoides** var. **microphyllus.**

BB. Corolla-lobes shorter than the tube; corolla not excessively gaping (except in **P. Palmeri** and var.).

C. Inflorescence spicate-racemose; flowers solitary or geminate; seeds winged.

a. Leaves gray with a short scabrous pubescence; corolla about 1 cm. long, glabrate, reddish; southern Sierras........................3a. **P. Rothrockii.**

aa. Leaves green, glabrate; corolla 13-15 mm. long, sparsely villous outside, yellowish; San Jacinto Mts............3b. **P. Rothrockii** var. **jacintensis.**

CC. Inflorescence thyrsoid; flowers usually geminate or several; seeds merely angled, not winged.

D. Leaves filiform to linear-spatulate or linear-lanceolate, 1-6 mm. wide.

E. Plant canescently strigose, with prostrate base and erect, subsimple stems, 5-15 cm. high; leaves oblanceolate to linear-oblanceolate, 8-15 mm. long; corolla bluish-purple. ....11. **P. linarioides** var. **californicus.**

EE. Plant glabrous, loosely branched, somewhat shrubby, 3 or more dm. high; corolla pink or rose-color.

F. Leaves linear to filiform, 0.6-2.0 mm. wide; plant not glaucous; sterile filament glabrous............................ ....20. **P. ambiguus** var. **Thurberi.**

FF. Leaves linear-lanceolate, 2-6 mm. wide; plant glaucous; sterile filament densely bearded in upper half.

a. Leaves 3-6 mm. wide; pedicels and sepals glabrous; Corolla with proper tube scarcely extending beyond the calyx...................14a. **P. fruticiformis.**

aa. Leaves 2-3 mm. wide; pedicels and sepals glandular-puberulent; corolla-tube proper twice the length of the calyx.......14b. **P. fruticiformis** var. **incertus.**

DD. Leaves various, mostly distinctly more than 6 mm. wide.

E. Plant 5-10 cm. high; branches of inflorescence pruinose; calyces and pedicels pubescent and more or less viscid; densely caespitose from a short, prostrate woody caudex. ....12. **P. calcareus.**

EE. Plant 2-12 dm. high; plants glabrous or glabrate; caudex if present, loosely branched and bushy (except in **albomarginata**).

F. Foliage and calyces conspicuously white-margined, corolla densely bearded within; stems about 2 dm. high, many from one base.............................13. **P. albomarginatus.**

FF. Foliage not conspicuously white-margined; corolla glabrate within; stems, if low, few in number.

G. Corolla blue; stem leaves below the inflorescence linear or lance-linear, entire..........16. **P. speciosus** var. **piliferus.**

GG. Corolla flesh-color or more or less purplish or reddish; upper stem-leaves lanceolate to ovate, generally dentate.

H. Corolla abruptly dilated with a much-inflated, widely gaping throat, white suffused with pink or lavender; sterile filament conspicuously exserted and heavily bearded.

a. Plants simple or with few tall, strict basal branches; upper cauline leaves strongly connate

perfoliate and 2-4 cm. broad, glaucous; inflorescence elongate, close, branches short and strict; eastern Mohave Desert...........15a. **P. Palmeri**

aa. Plants much branched at base; upper leaves scarcely if at all connate, less than 2 cm. broad, not glaucous; inflorescence open with well developed and spreading branches; mountains west of the deserts...........15b. **P. Palmeri** var. **Grinnellii.**

HH. Corolla gradually dilated, not with a strongly inflated and much gaping throat, definitely pink-purplish or bluish; sterile filament included, glabrous or short-bearded.

I. Corolla throat expanded dorsally as well as ventrally. 9-12 mm. wide; corolla 25-35 mm. long; sterile filament glabrous; coastal.................................19. **P. spectabilis.**

II. Corolla throat expanded mainly ventrally, throat 4-8 mm. wide; corolla 15-30 mm. long; deserts.

J. Corolla 25-30 mm. long, 7-9 mm. wide; plant 5-10 dm. high, more or less glaucous; sterile filament glabrous; eastern part of Colorado Desert..........18. **P. pseudospectabilis.**

JJ. Corolla about 20 mm. long, 5-6 mm. wide; plant 3-7 dm. high.

a. Upper leaves scarcely if at all connate-perfoliate, not glaucous; sterile filament usually glabrous; western edge of Colorado Desert from Coyote Canyon southward.............17a. **P. Clevelandi.**

aa. Upper leaves connate-perfoliate.

b. Plant very glaucous; sterile filament conspicuously bearded; western edge of Colorado Desert north of Coyote Canyon..17b. **P. Clevelandi** var. **connatus.**

bb. Plant slightly glaucous; sterile filament glabrous; eastern part of Mohave Desert..................
................17c. **P. Clevelandi** var. **Stephensi.**

TREATMENT OF SPECIES

√ 1. **Penstemon breviflorous** Lindl. Bot. Reg. 23:t. 1946. 1837.

A pale green, glabrous, glaucous shrub 1-2 m. high, forming loose, rounded clumps with many virgate greenish branches; leaves all opposite, coriaceous, entire or denticulate, narrowly lanceolate to narrowly elliptical, sessile or short petioled, 1-3 cm. long and 3-7 mm. broad, the uppermost reduced to linear bracts; inflorescence a loose panicle 4-15 cm. long and 3-4 broad; peduncles slender, 0.5-2.0 cm. long; pedicels 2-5 mm. long; sepals ovate to lanceolate, strongly glandular-pubescent in Southern California material, 5-7 cm. long, 2 mm. broad, with hyaline margin on lower half; corolla flesh-color, yellowish in bud, widely gaping, 13-17 mm. long, 8-10 mm. wide, tube 5-6 mm. long, finely pubescent within; upper lip arched, narrow, rose-tinged within, bristly and glandular-hairy without and having a small, erect, spurlike projection about 1 mm. long at the base of the two rounded lobes, these 1 mm. long; lower lip spreading, with rose-colored lines within, hairy without, the lobes about 7 mm. long, somewhat deltoid; anther-sacs divergent, 1 mm. long, the line of dehiscence continuous and along the entire length; filaments pubescent at base, sterile filament glabrous except at very base, not dilated at tip; capsule ovate, 5-6 mm. long.

Type locality: California, collected by Douglas probably in the Santa Lucia Mts. Isotype studied.

Occasional on dry rocky slopes of high Upper Sonoran and Lower Transition Zones in the mountains along the northern and western borders of the Mojave Desert: Cottonwood Creek Canyon!, Inyo Co., **Purpus in 1907** (UC); Emigrant Gap!, **M. E. Jones 3276** (BP); Tehachapi!, **Davidson in 1895** (DS) and **in 1907** (Davidson Herb., Muhlenbergia 4:66. 1908); Lancaster!, **Davidson in 1892** (DS, Parish, Zoe 4: 165. 1893); Mt. Pinos!, **Peirson 3237** (BP & Peirson Herb.); Liebre Mts.!, **Abrams & McGregor 409** (BP, DS & GH); Acton (Davidson, Cat. Pls. L. A. Co., 22. 1896); Zaca Mt.!, Santa Barbara Co., **Eastwood in 1902** (GH); Ft. Tejon & vicinity!, **Xantus 62** (GH).

2a. **Penstemon antirrhinoides** Benth. in DC. Prodr. **10**:594. 1846.

A bright green, bushy shrub, 1-2 m. high and of spreading, branching habit; old stems with exfoliating grayish bark, young twigs slender, brownish and generally finely puberulent; leaves entire and rarely remotely and inconspicuously dentate, gradually narrowed into short petioles which are corky thickened at base, linear to oblanceolate or narrowly elliptical, one nerved, glabrous or glandular-puberulent, 5-20 mm. long, 2-8 mm. broad; inflorescence leafy paniculate, 4-20 cm. long, 3-10 cm. broad; peduncles commonly 1-flowered, 1-2 cm. long; pedicels about 1 cm. long; sepals broadly ovate, 3-7 mm. long, 2-3 broad, obtuse; corolla a clear yellow, brownish in bud, somewhat villous outside, 15-18 mm. long, 12-15 broad, tube proper 2-3 mm. long, included in calyx, throat abruptly expanded; corolla widely gaping with a dorsal plication which extends onto the arched upper lip, the two lobes of which are somewhat reflexed, suborbicular, about 2 mm. long; lower lip expanded, lobes 5-7 mm. long, 4-5 mm. broad, rounded; anther-sacs divergent, 2 mm. long, glabrous, dehiscent along entire length and with slits confluent, yellow at time of maturity; filaments deep yellow, all heavily bearded at base, sterile filament about 12 mm. long, dilated toward tip, with a very heavy yellow beard on upper side of outer two-thirds; style arched, fitting into dorsal keel of corolla; capsule 7-8 mm. long, ovate-acuminate.

Type locality: "In California," collected by Coulter. Isotype examined.

Frequent on open, dry, rocky slopes of the Upper Sonoran Zone. Occurring in the interior portions of the coastal drainage from the southern border through San Diego!, Orange!, and Riverside! Counties into San Bernardino County! Reaching its northern limit at Banning!, **M. E. Jones in 1903** (BP); "north of San Bernardino," Coville (Contr. U. S. Nat. Herb. 4:169. 1893); and hills south of Ontario!, **Johnston in 1920** (BP). Ascending to an altitude of about 3000 ft.

2b. **P. antirrhinoides** var. **Micophyllus** (Gray) Munz & Johnston. Bull. Torrey Club **49**:43. 1922. **P. microphyllus** Gray, Pac. R. R. Rep. **4**:119. 1856. **P. Plummerae** Abrams, Bull. Torrey Club **33**: 445. 1906.

Sepals ovate-acuminate; twigs cinereous.

Type locality: "Williams Fork of the Colorado," Arizona.

In similar situations as the species; growing in the Upper Sonoran Zone of the desert area and ascending to about 5000 ft. alt. We have seen the following specimens: Providence Mts.!, **Munz, Johnston & Harwood 4059** (BP; cf. Bull. Torrey Club 49:43. 1922; similar plants reported as **P. antirrhinoides** by Brandegee, Zoe **5**:151. 1903); Kelso!, **M. E. Jones in 1906** (BP); Quail Springs!, **Munz & Johnston 5239** (BP); Palm Springs!, **Eastwood 2985** (CA); Old Nicholas Canyon!, Santa Rosa Mts., **Munz 5930** (BP); and Jacumba!, **Mearns** 3223 (DS).

3a. Penstemon Rothrockii Gray. Synop. Flora 2:260. 1886. **P. Schockleyi** Wats. Proc. Am. Acad. 23:265. 1888. **P. scabridus** Eastw. Bull. Torrey Club 32:208. 1905.

A loosely branched rounded shrub 3-6 dm. high, old branches rough, branches of the year simple, erect, slender, 1-4 dm. long, densely short pubescent, usually slightly glandular above, frequently canescent; leaves numerous, firm, oblong, varying to ovate and ovate-lanceolate, subsessile or with petioles 1 mm. long, grayish with a short scabrous pubescence, entire or remotely denticulate or with a crisped undulate margin; leaves reduced above and extending into the inflorescence mainly as alternate bracts; inflorescence remotely flowered, unilateral, racemose, 8-40 mm. long; flowers solitary or occasionally in groups of two or three; peduncles undeveloped or scarcely 1 mm. long; pedicels 1-1.5 mm. long; sepals lanceolate, 3-6 mm. long; corolla pale yellowish, tinged pink or brownish, 10-12 mm. long, 3-5 mm. broad, gradually dilated, subcylindrical, inside villous toward the base, outside puberulent or sparsely villous; upper lip straight, 3-5 mm. long with 2 broad lobes 0.8-1.3 mm. long; lower lip 3-5 mm. long, parted into 3 oblong recurved lobes; stamens evident; filaments 8-11 mm. long, dilated and (except 2 upper ones) short villous at base, about equalling upper lip; anther-sacs 0.8-1.2 mm. long, glabrous, spreading, dehiscent nearly to tip with slits of adjacent sacs confluent; capsule about equal to calyx.

Type locality: Little Olanche Mt., Kern River, California.

Known from Southern Sierras: Panamint Mine!, **Hall & Chandler 7005** (UC); and Charleston Mts. of adjacent Nevada and may be expected in our range.

3b. P. Rothrockii var. jacintensis (Abrams) comb. nov.

P. jacintensis Abrams. Bull. Torrey Club **33**:445. 1906.

Leaves glabrate, green; corolla 13-16 mm. long, 4-5 mm. broad.

Type locality: Tamarack Valley, San Jacinto Mts.

Common on partly shaded slopes and ridges under pines and firs in the San Jacinto Mts.!; where it occurs in the Transition and Canadian Zones from 7000 to 9500 ft. alt. (Hall, U. C. Pub. Bot. 1:120. 1902).

4. Penstemon cordifolius Benth. Scroph. Ind. 7. 1835.

A loosely branched scandent shrub clambering as high as 3 m., densely sordid pubescent in the inflorescence, otherwise commonly glabrous or sparsely inconspicuously puberulent, but in the interior frequently quite pubescent; leaves ovate or oblong-ovate, base cordate or occasionally obtuse, apex usually acute, rarely obtusish, margin more or less sharply serrate, texture firm, with veins impressed above and in relief below, except in extremely pubescent forms dull above and lighter colored and shiny below, 1.5-3.5 cm. long, and ½ cm. wide; petioles 2-5 mm. long with a persistent corky thickened base; inflorescence a crowded pendant deltoid thyrsus with large leafy bracts and divaricate or reflexed pubescent branchlets; inflorescence terminating branches 2-5 dm. long and itself 0.5-2.0 dm. long and 0.5-1.0 dm. broad; peduncles coarse, 1- to several-flowered, 5-30 mm. long; pedicels 5-15 mm. long; sepals lanceolate, 8-10 mm. long, 2-3 mm. broad, densely glandular-pubescent; corolla dull scarlet, tubular, glandular-pubescent without, glabrous within except on the lobes and very base of the tube, corolla 3.5 to 4 cm. long, the tube 18-20 mm. long and 6-7 broad, the upper lip 15-17 mm. long, straight, ending

in 2 rounded lobes about 2 mm. long; lower lip reflexed, 13-15 mm. long, parted into 3 ligulate, obtuse divisions 8-9 mm. long and 3-3.5 mm. broad; anther-sacs parallel, 1.5-2 mm. long, dehiscing throughout their length by a line continuous at the proximal ends; filaments dilated, pubescent at the base, fertile ones 3 cm. long, sterile one 18 mm., dilated at the tip and heavily bearded in the upper half; capsule ovate-acuminate, 10-13 mm. long; seeds 1-1.5 mm. broad.

Type locality: California, collected by Douglas probably at Santa Barbara. Isotype seen.

Frequenting the more densely growing parts of the chaparral, such as lower slopes and along small ravines, in the Upper Sonoran Zone of the coastal area from our southern border to Santa Barbara Co. Extending inland to City Creek!, San Bernardino Mts., **Johnston 2859** (BP); occurring also on the islands on which it is the only species of **Penstemon**: Catalina! (Lyon, Bot. Gaz. **11**:334. 1886; Millspaugh & Nuttall, Field Mus. Pub. Bot. **5**:224. 1923); San Clemente (Trask, Bull. So. Cal. Acad. **3**:95.1894); Santa Rosa (Brandegee, Proc. Cal. Acad. (2) **1**:215.1888) and Santa Cruz! (Greene, Bull. Cal. Acad. **2**:409.1887).

5a. Penstemon ternatus Torr. in Gray, Bot. Mex. Bound., 115. 1859.

Glabrous, glaucous shrub with long wandlike, slender stems, these sometimes scandent, 5-15 dm. high; leaves linear to lanceolate or lance-ovate, cuneate at base, ternate or rarely opposite, saliently serrulate, obtuse or acute at tip, rigid with conspicuous midrib, 1-5 cm. long, 2-10 mm. wide, very short petioled; leaves of inflorescence gradually reduced; inflorescence a narrow racemose panicle (sometimes branched), with glaucous stem, 1-5 dm. long, not over 4-10 cm. wide; peduncles slender, 0.5-1.5 cm. long, each commonly bearing several slender, glabrous pedicels mostly less than 1 cm. long; sepals ovate, mostly acuminate, 3-5 mm. long, finely short-ciliate; corolla tubular, scarlet, yellowish at base, very slightly enlarged outward, slightly constricted just beyond calyx, finely granular-pubescent, 2.5-3 cm. long, tube about 20 mm. long and 4 mm. wide, upper lip straight, 6 mm. long and 3 mm. wide, with 2 terminal lobes of 1 mm. length; lower lip reflexed and spreading, with 3 ligulate divisions each about 8 mm. long; corolla-throat glabrous, yellowish scarlet; the 2 longer stamens well exserted, about 25 mm. long, the 2 shorter ones 3 mm. shorter; sterile filament 15 mm. long, with short beard the entire length; bases of all filaments and of corolla-tube densely white-hairy; anthers divergent, dehiscence continuous and extending the length of both sacs, glabrous, 1 mm. long; capsule broadly ovate-acuminate, 8-9 mm. long.

Type locality: Mountains east of San Diego, California.

In chaparral of fairly dry slopes (but not those of greatest exposure, i. e., not with **Adenostoma fasciculatum** or its associates) in the Upper Sonoran and very low Transition Zones of the coastal drainage. Extending from the San Gabriel Mts. southward. Reaching the edge of the desert as at Warners Hot Springs!, **Mrs. Coombs** (CA); and Santa Rosa Mts!, **Munz** 5852 (BP). North of the San Gabriel Mts. the species is replaced by the following variety:

5b. **P. ternatus** var. **septentrionalis** var. nov.

Sepals and pedicels glandular-pubescent.

Type: **Abrams & McGregor 394,** Oakgrove Canyon, Liebre Mts. (GH).

Growing in the same habitat as the species in the coastal drainage north of the San Gabriel Mts. To it can be referred such specimens as: Tehachapi!, **Davidson in 1895** (UC); Mt. Pinos! **Dudley & Lamb 4769** (DS); Ft. Tejon!, **Xantus 63** (GH); Sandbergs!, Liebre Mts., **Munz 4418** (BP); Oakgrove Canyon!, **Abrams & McGregor 394** (DS, GH); and Mt. Gleason!, **Elmer 3597** (GH).

6. **Penstemon labrosus** (Gray) Hook f. Bot. Mag. 40:t.6738.1884; Gard. Chron. II, 20:536, f.91.1883. **P. barbatus** var. **labrosus** Gray. Bot. Calif. 1:622.1876.

Bright green, glabrous, perennial herb with a few simple, rarely branched, graceful stems from slender, often branching root-stocks; stems 2-6 dm. high with leaves mostly near the base; lower leaves oblanceolate to oblance-linear, practically sessile, progressively smaller up the stem, those of the inflorescence reduced to linear bracts; panicle slender, glabrous, 1-3 dm. long, almost racemose, secund, only the lower peduncles 2-, the others 1-flowered; peduncles slender, 0.5-2.0 cm. long; pedicels slender, of same length; sepals narrowly lanceolate to suborbicular, more or less acuminate, green, glabrous, hyaline-margined, 3-5 mm. long; corolla scarlet, tinged with yellow in the throat, yellowish to vermillion in the bud, tubular, 25-35 mm. long; throat very gradually dilated, 18-20 mm. long, 5-6 broad; upper lip straight 10-15 mm. long, with 2 short rounded lobes, about 3 mm. long; lower lip reflexed, divided into 3 narrow, ligulate spreading lobes 8-15 mm. long; stamens about the length of the upper lip of the corolla, yellowish at base, glabrous, the sterile one scarcely dilated; anthers strongly divergent, 1.5-2.0 mm. long, opening at distal ends, the slits not confluent; capsule up to 8 mm. long, ovoid-acuminate; seeds 2 mm. broad, irregularly angled, blackish.

Type locality: Mt. Pinos at 7000 ft. alt. Type seen.

Endemic to our area, where it is often confused with **P. Bridgesii.** Often frequent on dry slopes and benches in the open pine forests of the Transition and Canadian Zones from 5000 ft. to at least 10,000 ft. alt., as on San Jacinto Peak!, **Munz 6454** (BP). Occurring in San Diego Co.: Smith Mt!, **Orcutt 1012** (GH); Laguna Mts!, **Mrs. Spencer 961** (BP), **Randall in 1918** (DS); Hot Spring Mt!, **Buttle in 1913** (CA). Distributed northward through the San Jacinto Mts! (Hall, U. C. Pub. Bot. 1:119. 1902), Santa Rosa Mts!, **Munz 5841** (BP); San Bernardino Mts!, (Parish, Plant World 20:253. 1917); San Gabriel Mts!, (Johnston, Plant World 22:116. 1919); and Mt. Pinos!, **Dudley & Lamb 4572** (BP; cf. Coville, Contr. U. S. Nat. Herb. 4:170. 1893).

7. **Penstemon Munzii** Johnston. Bull. Torrey Club 49:40. 1922.

Herbaceous plant with several coarse, erect, loosely tufted glabrate stems that become at least 5 dm. high; leaves all opposite, entire and glabrate; basal leaves ovate- or lanceolate-spatulate with winged petioles that about equal the blade, becoming 7 cm. long and 2.5 cm. wide; lower cauline leaves oblanceolate, upper ones broadly sessile and lanceolate, those of inflorescence minute and linear-subulate; inflorescence narrow, the flowers in strict 1- to 3-flowered cymules; corolla bright red, 2 cm. long, narrowly funnelform-tubular, evenly though but slightly ampliated upward, strongly and conspicuously bilabiate, glabrous within; upper two lobes of the corolla straight, about 7 mm. long, united for about 2/3 their length, lower three lobes of the corolla strongly reflexed, about 6 mm. long, united for nearly half their length; anther-sacs glabrous, obscurely rugulose or papil-

lose, adnate if at all only near the base, ovate-oblong, 2-2.5 mm. long, their inner sides paralleling each other or forming a small angle, dehiscent by a slit extending between ⅔ and ¾ the way to the base, sharply dentate along the line of dehiscence; sterile filament glabrous, somewhat flattened, emarginate; sepals broadly ovate, acute, 3-5 mm. long, scarious margined; pedicels about as long as the sepals; fruit unknown.

Type locality: Providence Mts., Mohave Desert, California.

Known only from the type collection which grew on a high exposed ridge in the pinyon belt of the Providence Mts! More material of this species is greatly to be desired.

8. **Penstemon Eatoni** Gray var. **undosus** Jones. Proc. Cal. Acad. II, 5:715. 1895.

Green, finely puberulent herb with a few coarse erect stems, 3-8 dm. high; leaves mostly cauline, only the basal ones petioled, upper cauline clasping, lanceolate to ovate, 3-10 cm. long, 1-3 cm. broad, smooth, bright green; inflorescence a strict, secund, narrow thyrsus becoming 5 dm. long, but not more than 4 cm. wide; peduncles mostly several-flowered and not over 1 cm. long; pedicels rarely more than 1 cm. long; sepals ovate-lanceolate, acuminate, 6 mm. long, green with broad white margin; corolla scarlet to carmine-red, glabrous, narrowly funnelform, obscurely bilabiate, 25-32 mm. long, 5-8 mm. broad, lobes 3-7 mm. long, broadly ovate, not reflexed; anther-sacs about 2 mm. long, each with a slit extending from the distal end for about ⅔ the length; filaments 3 cm. long, dilated at base but glabrous; sterile filament slightly bearded at the flattened tip; capsule 10-12 mm. long, ovate-acuminate.

Type locality: St. George, Utah. Type examined.

Occasional on dry gravelly slopes and in canyon-beds of the Upper Sonoran Zone along the southern borders of the Mohave Desert, as at Cactus Flats!, San Bernardino Mts., **Munz 5747** (BP); Cushenberry! (Parish, Zoe 4:165. 1893); Pinyon Wells!, **Munz 4541** (BP); and Providence Mts. (Brandegee, Zoe 5:151. 1903).

Our material of **P. Eatoni** is apparently all to be referred to the variety **undosus**, although some of the plants are almost glabrous.

9. **Penstemon centranthifolius** Benth. Trans. Hort. Soc. London II, 1:481. 1835. **Chelone centranthifolius** Benth. Scroph. Ind. 7, 1835.

A glaucous, glabrous perennial with 1-several strict, leafy stems 3-10 dm. high, from a woody branching root-system; leaves all opposite, thick, entire, mostly cauline, the basal ones oblanceolate to spatulate, 2-8 cm. long and gradually narrowed into a petiole; cauline leaves mostly sessile, lanceolate to ovate, uppermost pairs with rounded or subclasping base, 2-12 cm. long and 0.5-5.0 cm. broad; inflorescence a leafless, elongated, racemose panicle rarely with open branching, from 1-4 dm. long and 2-5 cm. wide, more or less secund; peduncles 1- to several-flowered, 3-20 mm. long; pedicels 10-25 mm. long; sepals broadly ovate, 3-5 mm. long, tinged with red and with broad hyaline margin; corolla scarlet, with slight glaucous cast, subtubular, obscurely bilabiate, 22-27 mm. long, 4-6 mm. broad, the longest lobe 2.5 mm. long; anther-sacs about 1 mm. long, dehiscent by a continuous slit extending across the proximal end and down the length of each sac; stamens yellowish below and glabrous, sterile one adnate to corolla for two-fifths its length, flattened, slightly enlarged, yellow and glabrous at tip; capsule 10-14 mm. long, ovate-acuminate.

Type locality: California, collected by Douglas. Isotype examined.

Common in disturbed gravelly places, such as newly exposed areas on dry slopes, in sandy washes, and on dry fans. Occasional in fine alluvial soil as in the **Artemisia tridentata** association in Hemet Valley, San Jacinto Mts., **Munz 5787**. Occurring in the inland portions of the coastal area, from Jacumba!, **McGregor 104 & 1007** (DS) and Laguna!, San Diego Co., **Schoenfeldt 3541** (DS) to Mt. Pinos!, **Abrams & McGregor 210** (DS) and the Tehachapi Mts!, **Hall 6267** (UC) and **Xantus 61** (GH). Reaching the edge of the desert in many places, as San Felipe!, **Parish 9041** (DS); Santa Rosa!, Riverside Co., **Munz 5847** (BP); and Morongo Pass!, **Munz & Johnston 5195** (BP). We have seen one specimen from the desert proper, a collection by **Mrs. Marie Meiere** at Needles! in 1917 (CA).

A form with yellow corollas is sporadic.

10. Penstemon subulatus M. E. Jones. Contr. West. Bot. **12**:63. 1908.

Glabrous tufted perennial, glaucous throughout, with several slender simple erect stems from a thickened woody base, 2 to 3.5 dm. high; leaves opposite, basal leaves linear to oblanceolate to obovate, narrowed into winged petioles 0.5 to 1.5 cm. long; stem leaves all sessile with cordate base, grass-like, linear to linear-lanceolate, long-acuminate, 1 to 5 cm. long; inflorescence a narrow panicle, 10 to 20 cm. long, 4 to 6 cm. wide, rather open; peduncle 1- to several-flowered, 1 to 2 cm. long, somewhat spreading; pedicels 0.5 to 1.0 cm. long; sepals ovate, acute to acuminate, green with purplish tinge, hyaline margined below, 3 to 5 mm. long; corolla scarlet, narrowly tubular, 20 to 28 mm. long, 4 to 5 mm. wide, finely granular; the lobes 2 to 3 mm. long, suborbicular, anther-sacs broad, about 1 mm. long, divergent, dehiscent throughout, dehiscence continuous; filaments all glabrous; capsule ovate, 5 to 9 mm. long; seeds 2 mm. broad, strongly angled, brown.

Type locality: Hackberry, Arizona. Type studied.

Occurring in the extreme eastern portion of the Mohave Desert; we have record of but two specimens from California: Barnwell!, **K. Brandegee in 1911** (UC) and Ivanpah Mts!, **S. B. Parish 10317** (DS, cf. Parish, Bot. Gaz. **65**:341. 1918).

This species is very close to **P. centranthifolius**, perhaps too near it to deserve specific rank. Except for a single specimen of **centranthifolius** collected at Needles by **Mrs. Meiere** (CA) the two species have a distinct geographical distribution.

11. Penstemon linarioides Gray var. **californicus** var. nov.

Perennial; stems erect, 5-15 cm. high, canescent with reflexed, flattened strigose hairs, commonly simple, from a shrubby caudex with long, dark-barked prostrate branches; leaves thickish, veinless, entire, distinctly wider in upper half, equally strigose-canescent on both surfaces, largest 8-15 mm. long and 1.5 to 2.5 mm. wide, mucronate, gradually reduced up the stem and in the inflorescence less than 4 mm. long and 1.5 mm. wide; inflorescence a narrow thyrse 5-8 cm. long and 15-20 mm. wide, the strict or ascending branches and pedicels each 0.5 mm. long; sepals ovate, acute, 3.5 to 5 mm. long, more or less strigose and occasionally somewhat glandular; corolla blue with purplish cast, 14-18 mm. long, strongly bilabiate, sparsely pubescent without and weakly bearded on base of lower lip; tube 4-5 mm. long and 2-2.5 mm. wide, throat weakly but noticeably inflated, 4-6 mm. broad, doubly plicate ventrally, these ridges white as is a line at the lower edge of the throat; upper lip 6 mm. long with 2 lobes almost 3 mm. long; lower lip 4 mm. long, with 3 lobes 2 mm. long; sterile filament scarcely dilated, included, short bearded; fertile filaments with few or no hairs; anther-sacs extremely divergent,

oblong, 1 mm. long, joined and dehiscent throughout, suture minutely serrulate.

Type: **Munz & Johnston 5445**, Kenworthy, Hemet Valley, San Jacinto Mts. (BP, no. 14405).

Local on warm gentle stony slopes at the upper edge of the Upper Sonoran Zone from Lower California, Cantillas Mts!, **Orcutt 893** (GH, cf. Goldman, Contr. U. S. Nat. Herb. **16**:365. 1916) to Aguanga!, **S. B. & W. F. Parish 1388** (UC and GH, distributed as **P. pumilus** var. **incanus**) and Kenworthy!, **Munz & Johnston 5445** and **Munz 5976** (BP).

Our plants differ from the typical **P. linarioides** in their extreme western range and in having broader oblanceolate leaves up to 2.5 mm. wide and not more than 15 mm. long, and a very weak beard on the lower lip of the narrower corolla. In the typical form the leaves are linear, about 1.5 mm. wide and 20 mm. long and the corolla lip is strongly bearded.

12. Penstemon calcareus Brandegee. Zoe **5**:152. 1903; not Jones. 1908. **P. desertorum** Jones. Contr. West. Bot. **12**:59. 1908.

Plant densely caespitose, 3-10 cm. high, densely puberulent throughout, pallid, green tending to become purplish with age; leaves firm, entire or occasionally with a few denticulations, mainly basal; lower leaves with ovate to elliptic blades, 1 to 3.5 cm. long and with narrowly winged petioles of about equal length; cauline leaves in several pairs, linear-oblong to lanceolate, acute, 2-4 cm. long, middle ones petiolate, uppermost sessile; inflorescence verticillate with usually less than 12 flowers, first dense but in fruit becoming 3-4 cm. long; peduncles undeveloped; pedicels 2-3.5 mm. long, short viscid-villous as are the sepals; sepals about 4 mm. long, lanceolate or linear, becoming 7-8 mm. long; corolla pink, 10-12 mm. long, subtubular, being gradually and not strongly ampliated, 4 mm. broad, puberulent outside, glabrate within; upper lip 3.5 mm. long, the two lobes about 2 mm. long, tending to spread; lower 3 lobes 2 mm. long, usually straight; sterile filament included, 11 mm. long, densely bearded, fertile filaments glabrous; anther-sacs divergent, 1 mm. long, glabrous, dehiscent the entire length, the slits of the paired sacs completely confluent; capsule spherical or ovate, exceeded by sepals, 4-5 mm. long; seeds unknown.

Type locality: Providence Mts., Mohave Desert, California.

Occasional in rock-crevices, probably of limestone cliffs, in the Upper Sonoran Zone of the Providence Mts!, eastern Mohave Desert; known from three collections (Munz & Johnston, Bull. Torrey Club **49**: 42. 1922).

13. Penstemon albomarginatus Jones. Contr. West. Bot. **12**:61. 1908.

A pale green, entirely glabrous, shiny plant, forming crowded clumps 2-3 dm. high; stems numerous, somewhat fleshy, strict, simple or with several strict laterals, arising from a deep, much-branched fleshy root; leaves firm, entire, with a narrow, white hyaline margin, distinct, oblanceolate to spatulate or suborbicular with an abruptly contracted, elongate cuneate, petiolar base, 1-nerved, 2-5 cm. long, 4-10 mm. wide, lower obtuse, upper somewhat acute, gradually reduced up the stem but extending through the inflorescence as conspicuous leafy bracts; inflorescence a spicate simple thyrsus, 6-15 cm. long, 2 cm. broad, leafy; peduncles usually undeveloped, but in lowest flowers as much as 4 mm. long; pedicels slender, 4-10 but commonly 5 mm. long; sepals oblong to lanceolate, 5-6 mm. long, 1.5-2.5 mm. wide with a broad hyaline margin; corolla "light pink with a

purplish tint," 15-18 mm. long; lobes ascending or spreading, 3 lower semi-circular, nearly 2 mm. long, 2 upper suborbicular, nearly 4 mm. long; corolla throat 4-6 mm. broad, scarcely inflated, narrowly funnelform, about 10 mm. long, densely bearded, as is tube almost to base; tube doubly plicate ventrally; anther-sacs divergent, 1-5 mm. long, glabrous, dehiscent nearly whole length, slits of the two sacs confluent; sterile filament glabrous, nearly 1 cm. long, not dilated toward tip; capsule 7-9 mm. long, ovate-acuminate; seeds 1.5-2.0 mm. broad, irregularly angled, finely but deeply alveolate.

Type locality: Good Spring Station, Nevada. Type examined.

Known in Southern California from a single collection made in a sandy wash on the Mohave Desert near Lavic!, **Munz, Johnston & Harwood 4204** (BP; cf. Bull. Torrey Club 49:44. 1922).

14a. **Penstemon fruticiformis** Coville. Contr. U. S. Nat. Herb. 4:170. 1893.

Glaucous, mostly glabrous shrubby plant, much branched from the base, 3-5 dm. high; leaves linear-lanceolate, entire or obscurely denticulate, 2-6 cm. long and 3-6 mm. wide; upper ones sessile or with winged petioles; inflorescence a few-flowered open thyrse, 5-15 cm. long, peduncles glabrous, 1- to 2- or 3- flowered, 1-2 cm. long; pedicels glabrous, 1-2 cm. long; sepals broadly ovate, short-acuminate, distinctly hyaline margined, glabrous, 5 mm. long; corolla "pink or pale rose-color," light brown in dried specimens abruptly dilated and with widely gaping throat, 23-27 mm. long, 12-15 mm. wide, tube 15-17 mm. long, the lobes rounded, the lower ones reflexed, the corolla-tube proper scarcely extending beyond the calyx, lower lip well bearded; anther-sacs 1.5 mm. long, explanate, dehiscent throughout their length, the lines of dehiscence continuous; sterile filament densely bearded in the upper half; capsule 1-1.5 cm. long, ovate-acuminate.

Type locality: Wild Rose Canyon, Panamint Mts., California.

We have seen no specimens exactly typical of the species from the territory covered by this paper.

14b. **P. fruticiformis** var. **incertus** (Brandegee) Munz & Johnston. comb. nov.

P. incertus Brandegee. Bot. Gaz. 27:455. 1899.

Leaves narrowly linear-lanceolate, 2-3 mm. wide; pedicels and sepals glandular-puberulent; sepals lance-ovate long-acuminate, indistinctly hyaline-margined, 5-7 mm. long; corolla tube proper twice the length of the calyx; lower lip of the corolla at most sparingly bearded; dried flowers dark brown.

Type locality: Argus Mts., California.

Known from a few collections in scattered portions of the Mohave Desert: Between Willow Springs and Tehachapi!, **Abrams & McGregor 429** (BP, DS) and Mohave!, **Parish 9270** (DS).

While the characters given above seem to set this quite apart from typical **P. fruticiformis,** even the small series of specimens available to us show such intergradation as to warrant the reduction of **incertus** to varietal rank. The Parish specimen from Mohave has leaves 4-5 mm. wide and older pedicels and some sepals quite glabrous, while some sepals are long-acuminate and others short. **Parish 3151** (DS) from Warrens Well, which was distributed as **P. glaber utahensis** (Erythea 3:61. 1895) has the leaves 2-3 mm. wide and pedicels and sepals quite glabrous, the latter being short-acuminate. Yet in spite of these inter-grades, we do not feel that we have seen enough material to warrant the reduction to synonymy as done by Krautter (Trans. & Proc. Bot. Soc. Penn. 2:122. 1911).

15a. Penstemon Palmeri Gray. Proc. Am. Acad. 7:379. 1868.

Biennial or perhaps perennial plant with few coarse straight stems, 5 to 10 dm. in height, glabrous and glaucous below, glandular pubescent in the inflorescence; basal and lower cauline leaves petioled, orbicular to obovate to ovate, 2-10 cm. long glaucous, coriaceous, coarsely jagged-serrate; upper cauline leaves sessile, some connate, strongly glaucous, jagged-serrate, acute to acuminate, 3-12 cm. long, the uppermost reduced to ovate-acuminate bracts; inflorescence a racemose unilateral thyrse, 2-6 dm. long and 4 cm. broad; peduncles 1- to several-flowered 5-15 mm. long, glandular-puberulent, as are the pedicels, the latter 5-30 mm. long; sepals lanceolate to ovate glandular-puberulent, green with narrow hyaline margin, 5-8 mm. long; corolla flesh-colored, "white, more or less suffused with pink," 25-30 mm. long, glandular-puberulent without, abruptly dilated with a much inflated widely gaping throat 18 mm. long and 15 mm. broad, minutely pubescent within; upper lip slightly 2-lobed, broad rounded somewhat reflexed; lower lip 3-parted, widely spreading, at least sparsely bearded; anther-sacs ovate, glabrous, 3 mm. long, divergent, lines of dehiscence confluent; filaments with short pubescence below, fertile ones mostly included; sterile filament conspicuously exserted and with dense, long yellow beard on the dilated upper end; capsule ovate, 12 mm. long, sparsely pubescent; seeds slightly angled.

Type locality: Skull Valley, Arizona.

Known in California from only a few collections in dry rocky gullies and on slopes of the Upper Sonoran in the eastern part of the Mohave Desert: Providence Mts!, **Brandegee** (UC), **Munz, Johnston & Harwood 4276** (BP; cf. Bull. Torrey Club 49:41. 1922); Leastalk! **Parish 10262** (DS); Kelso!, **Jones in 1906** (BP).

15b. P. Palmeri var. **Grinnellii** (Eastwood) Munz & Johnston. Bull. Torrey Club 49:22. 1922. **P. Grinnellii** Eastwood. Bull. Torrey Club 32:207. 1905.

Habit low and branching; stems decumbent at base, 1-4 dm. high; not glaucous; cauline leaves usually not connate; inflorescence more lax and open, pyramidal, 1-2 dm. long, and 4-6 cm. broad; corolla somewhat smaller, flesh-color, sometimes with bluish tinge, upper lip deep lavender, lower lip pale lavender, with purplish lines and often more strongly bearded than in the species.

Type locality: Mt. Wilson, San Gabriel Mts., California.

Occurring, often as a very common plant, on dry slopes and ridges of the higher mountains from the Santa Rosa Mts!, **Munz 5826** (BP) northwestward. Occasional in the San Jacinto Mts!, common in the San Bernardino! and San Gabriel! ranges, extending into the Liebre Mts!, **Abrams & McGregor 335** (DS) and the Mt. Pinos region!, **Hall 6340** and **Abrams & McGregor 268** (DS). The altitudinal range is from 4000 ft. to 10,000 ft. Davidson's reference (Muhlenbergia 4: 66. 1908) to the occurrence of **P. Palmeri** in the Tehachapi Mts. is no doubt based upon a plant of this variety.

An apparent hybrid between this variety and **P. heterophyllus** from Seymour Creek, Mt. Pinos, **Munz 6999** (BP) has a woody base, the habit, and leaf-shape of **P. Palmeri** var. **Grinnellii** (though the leaves are only slightly dentate and somewhat glaucous) and the flower-shape, and anther-sacs of **P. heterophyllus** (though the flowers are a purplish-lavender rather than blue). Only a single plant of this sort was found; it cannot be referred to any described species.

16. **Penstemon speciosus** Dougl. var. **piliferus** (Heller) nov. comb. **P. piliferus** Heller. Muhlenbergia 2:136. 1906.

Strictly herbaceous, glabrous, green perennial with small tufts of several ascending stems from 1 to 5 dm. high; lower leaves smooth, oblanceolate to oblance-linear, 3 to 10 cm. long narrowed into winged petioles; upper leaves linear or lance-linear to lance-ovate, none connate; all leaves entire; lower leaves of infloresecnce quite conspicuous, only the upper ones reduced to minute bracts; inflorescence a rather dense, simple thyrse, glabrous, 1 to 3 dm. long, 4 to 6 cm. wide; with peduncles 1- to several-flowered, 5 to 10 mm. long; pedicels 4 to 8 mm. long; sepals 5 to 10 mm. long, ovate, acute, or short-acuminate, green, sometimes tinged with blue, glabrous, plainly hyaline margined; corolla bright blue, glabrous, funnelform, quite strongly inflated, especially ventrally, 30 to 35 mm. long, the inflation beginning at 10 to 14 mm. from the base; upper lip suberect, 8 to 10 mm. long, broad, with 2 rounded lobes about 6 mm. long; lower lip reflexed, spreading, 8 to 10 mm. long, with 3 rounded lobes of 6 mm. length; anther-sacs 2.5 to 3 mm. long, glabrous, somewhat divergent, dehiscing for most their length, but the lines of dehiscence not confluent; filaments glabrous except for short yellowish beard near summit of the included sterile filament; capsule broadly ovate-acuminate, 12-15 mm. long; seeds black, 1 mm. long, much lobed.

Type locality: Near Yreka, California.

Growing on dry valley-floors and gentle slopes of the Upper Sonoran and Lower Transition Zones about the western borders of the Mohave Desert. Sometimes very abundant locally, but known from but few collections: Cox Ranch, San Bernardino Mts!, **Parish 1848** (DS & GH); Swartout Valley!, San Gabriel Mts., **Hall 1259, 1539** (DS), **Abrams & McGregor 643** (DS & GH); **Munz 4620, Peirson 3193** (BP); Mt. Pinos!, **Munz 6976** (BP), **Elmer 4003** (GH); and Tehachapi Mts!, **Davidson in 1895** (DS; cf. Muhlenbergia 4:66. 1908) and **Abrams & McGregor 437** (DS & GH).

Differing from the species in its bearded sterile filaments and more southern range.

17a. **Penstemon Clevelandi** Gray. Proc. Am. Acad. 11:94, 1876.

Entirely glabrous perennial with woody base and several strict stems 4-7 dm. high and with several pairs of cauline leaves; lower leaves petioled, ovate, 2-5 cm. long and 1-2 broad; upper ones sessile, ovate, entire or denticulate, distinct, 1-4 cm. long and 1-2 broad, those of inflorescence reduced to leafy bracts; inflorescence a narrow, racemose panicle, 1-3 dm. long, apparently secund; peduncles usually 2- or more-flowered, 1-12 mm. long; pedicels 8-18 mm.; sepals ovate to suborbicular, 4-5 mm. long, hyaline margined; corolla purplish-red, tubular-funnelform, about 2 cm. long, 5-6 mm. wide, straight above, somewhat inflated ventrally, the lobes 3-5 mm. long, rounded; anther-sacs about 1 mm. long, divergent, opening along their entire length by a continuous line of dehiscence; filaments white below, purplish above; sterile filament slightly dilated; glabrous or weakly bearded; capsule broadly ovate, 8-10 mm. long.

Type locality: "The type specimen of **P. Clevelandi** must have been collected in the vicinity of Buckman's Spring—which is about ten miles east of Campo. I never collected in Canyon Tantillas, Lower California" (the type locality always cited), Cleveland in lit., 1922. Type seen.

Growing in the Sonoran Zones along the western edge of the Colorado Desert from Lower California to Mountain Springs!, **Brandegee** (UC) and Coyote Canyon!, **Hall 2766** (UC). Occasionally getting into the eastern part of the coastal drainage, as at Agua Caliente!, **Brandegee** (UC), and near Campo!, **Abrams 3619** (DS & GH).

17b. **P. Clevelandi** var. **connatus** Munz & Johnston. Bull. Torrey Club 49:357. 1923.

Habit and flowers of the species, but strongly glaucous; lower leaves and sometimes upper jagged-serrate, the upper 3 or 4 pairs connate-perfoliate; sterile filament well bearded.

Type locality: "Van Deventers, southeastern base of the San Jacinto Mts." Type examined.

On sandy banks and dry rocky slopes and mesas of the Sonoran Zones in the Palm Springs region!, **Eastwood 2979** (CA), **Johnston** (BP), **Parish 1216** (UC); and at Van DeVenter!, **Hall 1160 & 2149** (UC), and Old Nicholas Canyon!, **Munz 5931** (BP).

In almost every character this variety grades into typical **Clevelandi.** The leaves of **connatus** may be entire or weakly dentate. Although **Clevelandi** may have some beard on the sterile filament, no specimens of **connatus** have been seen which completely lack connate-perfoliate leaves.

17c. **P. Clevelandi** var. **Stephensi** (Brandegee) Munz & Johnston. Bull. Torrey Club 49:41. 1922. **P. Stephensi** Brandegee. Zoe 5:151. 1903.

With the general aspect of the variety **connatus;** the upper pairs of its jaggedly serrate leaves connate-perfoliate; foliage weakly glaucous; sterile filament glabrous.

Type locality: Providence Mts., Mohave Desert. Type examined.

Known from only two collections on high rocky slopes of the Upper Sonoran Zone in the Providence Mts. (Munz & Johnston, l.c.).

The plant has some of the characters of typical **P. Clevelandi** and some of the var. **connatus** and to us represents only a variety of a polymorphous species. We have seen the type and numerous specimens of **P. Clevelandi** and are certain that it has purplish-red and not scarlet flowers as insisted by Brandegee (Bull. Torrey Club 50:215. 1923). In color of corolla **P. Clevelandi** and the var. **Stephensi** are quite similar, though the latter is not so deep in color.

18. **Penstemon pseudospectabilis** M. E. Jones. Contr. West. Bot. 12:66. 1908.

A tall perennial with several erect stems from a common base; glaucous and glabrous except in the inflorescence; 3-12 dm. high; lower leaves 2-15 cm. long, ovate to lanceolate and oblanceolate, with long, well-defined petioles, jagged-serrate, glaucous; upper cauline leaves broadly ovate, connate, jagged-serrate to almost entire, glaucous; those of the inflorescence reduced to ovate-acuminate bracts; inflorescence 1 to 5 dm. long, a narrow strict, racemose thyrse, minutely glandular-puberulent; peduncles 1- to several-flowered, slender, erect, 5 to 10 mm. long, glandular; pedicels 5-20 long, erect, glandular-pubescent; calyx and peduncles tending to be tinged with red; sepals 6-8 mm. long, ovate to lance-ovate, finely pubescent, with thin hyaline or purplish margin; corolla purplish-red, finely glandular-puberulent, narrowly funnelform, 25-30 mm. long, the throat inflated ventrally, 22 mm. long, 7-9 mm. wide; upper lip reflexed, parted into rounded lobes, 3-4 mm. long; glandular-pubescent; lower lip recurved, divided into 3 rounded lobes 4-5 mm. long, glandular-pubescent; corolla-tube mostly glabrous within; anther-sacs 1 to 1.5 mm. long, strongly divergent, with continuous line of dehiscence; all filaments glabrous; ovary ovate-acuminate, glabrous 6 to 10 mm. long.

Type locality: Chimihuevis Mts., Arizona.

Known in California from only the extreme eastern part of the Colorado Desert, where two collections have been made in the Lower Sonoran Zone, in a sandy wash in the Chuckwalla Mts!, **Childs** (UC) and **Munz & Keck 4909** (BP & GH).

19. **Penstemon spectabilis** Thurber in Gray Pac. R. R. Rep. 4:119. 1856.

Large glabrous and often slightly glaucous perennial with several coarse erect stems from a woody base; up to 12 dm. high; lower leaves ovate to oblanceolate, somewhat coriaceous, petioled, mostly coarsely serrate, 2 to 10 cm. long, 1 to 5 broad; the upper ones connate-perfoliate, those of the inflorescence reduced to bracts; inflorescence a many-flowered, glabrous, much branched, often open panicle with slender, spreading, 1- to several-flowered peduncles from 1 to 3 cm. long; pedicels of same type and length; sepals 3 to 7 mm. long, lance-ovate to ovate-orbicular, obtuse or acute, greenish with hyaline margin; corolla purplish-red to bluish, finely glandular-pubescent, broadly funnelform, with throat strongly inflated dorsally as well as ventrally, though the latter expansion is the more prominent, corolla 25-35 mm. long, the throat 18-25 mm. long, narrow for about one-half its length, throat 9 to 12 mm. wide; upper lip reflexed, 8 to 10 mm. long, glandular-puberulent, with 2 rounded lobes 4 mm. long; lower lip somewhat reflexed, glabrous except for minute hispidulous row bordering each side of line of dehiscence, anthers strongly divergent, lines of dehiscence confluent; filaments all glabrous; capsule narrowly ovate, acuminate, glabrous, 10-12 mm. long; seeds 1.5 to 2 mm. long, dark, strongly angled.

Type locality: San Pasqual, San Diego Co., California, acc. to Thurber's specimens in Gray Herbarium.

Common in recently disturbed areas, such as dry washes and along trails, slides, and roads in the Upper Sonoran Zone. Occurring in the coastal drainage from the southern border to the Liebre Mts!, **Dudley & Lamb 4354** (DS). Reaching the edge of the desert as at Santa Rosa Mts!, **Hall 954** (UC); Coyote Canyon!, **Hall 1893** (UC); and Warners Hot Springs!, **Mrs. Coombs in 1919** (CA).

Penstemon Parishii Gray (Proc. Am. Acad. 17:228. 1882) is a perennial herb with the habit of **P. spectabilis**, but it is less woody; the inflorescence and flowers suggest those of **P. spectabilis**, but the stem and leaves are glaucous and in other respects much like those of **P. centranthifolius**, although the leaves may be denticulate. The hybrid origin of **P. Parishii** was originally suggested by Hall (U. C. Pub. Bot. 1:119. 1902) and by Davidson (Bull. So. Cal. Acad. 1:141. 1902). The plant has been found only in localities where both **spectabilis** and **centranthifolius** grow. We know of the following collections: Campo!, **Cleveland** (UC); Warners Hot Springs!, **Mrs. Coombs** (CA); Banning!, **Jaeger** (BP); Cajon Station!, **Johnston 2308** (BP); San Bernardino!, **S. B. & W. F. Parish** (UC), **Parish 8032** (CA), **S. B. Parish in 1901** (DS); Cucamonga Mt!, **S. B. & W. F. Parish 355** (UC); Cucamonga!, **Wallace** (GH); and San Gabriel Canyon!, **Eastwood 9004** (CA).

20. **Penstemon ambiguus** Torrey var. **Thurberi** (Torrey) Gray. Proc. Am. Acad. 6:65. 1862. **P. Thurberi** Torrey Pac. R. R. Rep. 7:15. 1856.

Glabrous plants with few strict somewhat shrubby stems, freely and ascendingly branched above, and becoming 15 dm. high; leaves linear-filiform, 0.6-2.0 mm. wide, 2.5-5.0 cm. long, entire, obtuse, sessile,

all opposite, not crowded, gradually reduced up the stem; inflorescence falsely racemose, open, 5-15 cm. long, less than 4 cm. wide, branches ascending or spreading, 2-12 mm. long, 1- or rarely 2-flowered; pedicels with subulate bracts at base, 1-6 mm. long; calyx 2 mm. long in flower, 4 in fruit, cut to near the base into ovate narrowly scarious-margined lobes; corolla pink or rose-color, obliquely salverform, about 15 mm. long; tube 5-6 mm. long, 1.5-2 wide; throat funnelform, about 6 mm. broad, 5 mm. long, pubescent inside; upper edge of flower nearly straight, upper lobes about 3 mm. long, lower ones 5, straight or slightly spreading; stamens included, glabrous, anthers glabrous, sacs about 7 mm. long, at first weakly spreading, later strongly divergent, dehiscent the entire length, lines in the two sacs confluent; capsule 7-8 mm. long, ovate-mucronate; seeds elongate, somewhat flattened, irregularly angled; black, finely alveolate.

Type locality: Burro Mts., New Mexico.

To our knowledge this plant has been collected in California only at San Felipe! on the western edge of the Colorado Desert by **S. B. & W. F. Parish 1389** (DS, GH & UC; cf. Parish, Zoe 4:165. 1893) and by **Abrams, 3978** (DS).

21. Penstemon Bridgesii Gray. Proc. Am. Acad. 7:379. 1868.

A perennial herb with strongly developed, often highly branched caudex, almost woody at base, with several erect or ascending stems 2-5 dm. high, glabrous below, glandular-puberulent in the inflorescence; leaves entire, mainly near the base of the stems, lower 2-10 cm. long, 2-9 mm. broad, oblanceolate, narrowed to a winged petiole; upper 1-3 cm. long, linear to lanceolate, sessile; inflorescence a narrow racemose thyrsus, 8-30 cm. long and 3-5 cm. broad, with narrow foliaceous bracts; peduncles 1- to several-flowered, 4-16 mm. long; pedicels 4-8 mm. long, both pedicels and peduncles glandular-puberulent; sepals glandular-puberulent, ovate, 4-5 mm. long, 1-2 mm. broad, margin hyaline; corolla scarlet, tinged with yellow in throat, finely pubescent without and within, 20-28 mm. long, 6-8 mm. broad, tube 16-18 mm. long, weakly dilated; upper lip straight, somewhat hooded at the end, 2-lobed; lower lip recurved, 3-parted; anther-sacs parallel, opening by short confluent slits at the proximal end, glabrous, with a stiff short pubescence along the line of dehiscence; filaments glabrous, sterile filament not much enlarged; capsule 7-9 mm. long, ovate; seeds 1-1.5 mm. broad, minutely alveolate, irregularly winged.

Type locality: California, collected by Bridges somewhere in the Middle Sierras. Type examined.

Often exceedingly common locally in clearings and under pines on dry benches, ridges, and slopes of the Transition and Canadian Zones, ascending from an altitude of about 4500 ft., Van Deventer Flat!, **Hall 940** (UC), to over 10,000 ft., ridge east of Mt. San Bernardino!, **Munz 6231** (BP). Ranging from our southern border, Smith Mt!, San Diego Co., **Stokes** (DS), and Laguna Mts!, **Randall** (DS), through the San Jacinto Mts!, (Hall, U. C. Pub. Bot. 1:119. 1902). San Bernardino Mts!, (Parish, Plant World 20:253. 1917), San Gabriel Mts!, **Johnston 1557 & Munz 6096** (BP) to the Mt. Pinos region!, **Hall 6620** (UC), Frazier Mt!, **Elmer 3747** (GH), and Tehachapi Mts., (Davidson, Muhlen. 4:67. 1908), and then northward and eastward.

22. Penstemon caesius Gray. Proc. Am. Acad. 19:92. 1883.

Caespitose, forming clumps several dm. across and 1-5 dm. high, glaucous, glabrous up to the inflorescence, much branched at base;

leaves mainly basal, glaucous, glabrous, subcoriaceous, the lower ones ovate to suborbicular, abruptly contracted to a narrow petiole which is 1-2 cm. long, the blades 10-17 mm. broad, upper leaves in one or two pairs, oblanceolate to oblong, sessile; inflorescence an open and few-flowered pánicle, largely glandular-pubescent and with narrow leafy bracts; peduncles 1- to several-flowered, 1-3.5 cm. long; pedicels 2-8 mm. long; sepals green with purplish tinge, ovate to oblong, 3-5 mm. long, 2 mm. broad, glandular-pubescent, with hyaline margin on lower half; corolla of a light purple color with a bluish sheen, finely pubescent without, and within on the lobes, 18-22 mm. long, 5-7 mm. broad, the lobes only about 3 mm long; corolla subcylindrical, gradually dilated then somewhat constricted, tube doubly plicate ventrally, the plications and two bands at junction of upper and lower lips white, the 5 lobes quite regular, suborbicular; anther-sacs parallel, dehiscent only over proximal end, glabrous except for stiff hairs along line of dehiscence; filaments all glabrous, sterile filament not dilated; capsule ovate, 7 mm. long.

Type locality: San Bernardino Mts., California. Type studied.

Common in large parts of the San Bernardino Mts!, (Parish, Plant World **20**:253. 1917); growing on dry slopes and ridges, particularly in disintegrated granite in Transition and Canadian Zones from 6000 ft. alt. to near the summit of Mt. San Gorgonio. One collection from Mt. Islip! in the San Gabriel Mts., **F. Grinnell Jr.** (Davidson Herb.); another reported from Cucamonga Peak in the same range (Davidson & Moxley, Fl. So. Calif., p. 330. 1923). Otherwise known only from the Sierra Nevada of Tulare Co.

23a. Penstemon heterophyllus Lindl. Bot. Reg. **22**:t. 1899. 1836.
P. leucanthus Greene, Pittonia **1**:72. 1887.

Shrubby at base, forming clumps 3-7 dm. high, glabrous throughout; leaves entire, 2-5 mm. wide, acute to obtuse; lower leaves oblanceolate to oblance-linear, 25-65 mm. long, gradually tapered to a petiole; upper leaves gradually reduced, linear to lance-linear, mainly sessile; inflorescence less than 5 cm. broad, appearing spicate; branches strict 1-10 mm. long, bearing 1-2 flowers; pedicels with linear bracts at base, 1-4 mm. long; sepals 4-6 mm. long, oblong or lanceolate, usually acute, frequently reflexed; corolla 25-30 mm. long, tube 7-9 mm. long, 2-2.5 mm. wide; throat inflated, 7.5-10 mm. broad, the lower lip 6-8 mm. long, spreading; upper lip straight, 4-6 mm. long; stamens included, entirely glabrous; sterile one 20-23 mm. long, with a dilated flattened rounded tip; anthers horse-shoe shaped; lines of dehiscence ciliate with rather coarse subulate processes, confluent at distal ends of sacs and extending down outer sides to below middle; sinus glabrous or very rarely with a few short villous hairs; capsule ovate, 8 mm. long; seeds irregularly angled, closely tuberculate, blackish.

Type locality: "California," collected by Douglas, probably south of Monterey.

This typical form of the species is rarely met in Southern California, though common to the northward. To it we refer the following collections: Sespe Creek!, **Abrams & McGregor 164** (DS, GH); Mt. Gleason!, **Elmer 3707** (GH); and "Los Angeles, Calif."! **Wallace** (GH); and Pine Hills!, San Diego Co., **Spencer 310**, in part (GH, BP).

23b. P. heterophyllus Lindl. var. **australis** nov. var.

Stems, and, to less extent, the foliage densely puberulent. Type: **C. F. Baker 4778,** Claremont, California. (Baker Herbarium of Pomona).

This variety includes the bulk of the material from Southern California, as well as much of that from further north. In our range it flowers from May to August, and occurs in open places such as fire-breaks, along trails and margins of woods, in both Upper Sonoran and Lower Transition Zones over the entire coastal drainage. Extending inland to Descanso!, **Munz & Harwood 7164** (BP); Cuyamaca Lake!, **Munz & Harwood 7210** (BP); Spencer Valley!, near Julian, **Abrams 3788** (DS); Mill Creek!, San Bernardino Mts., **Parish in 1889** (DS); Oak Glen!, **Wilder 332** (BP); and Bouquet Canyon!, **Munz 6923** (BP).

Such references as that of McClatchie (Flora Pasadena & vicinity in Reid, Hist. of Pasadena, 642, 1895) and of Davidson (List. Pls. L. A. Co., 13. 1892), to **"Penstemon azureus"** no doubt refer to **P. heterophyllus,** and for the most part to the var. **australis.**

24. **Penstemon laetus** Gray. Proc. Boston Soc. Nat. Hist. 7:147. 1859.

A loosely tufted plant 2-6 dm. high, pubescent with short, coarse strigose hairs; leaves entire, obtuse or broadly acute, 5-10 mm. wide, lower oblanceolate, 3-6 cm. long, gradually tapered to narrow base; upper leaves rapidly reduced up the stem and sparse, oblong or lanceolate, broadly sessile by a rounded base; inflorescence an open, more or less glandular thyrse, commonly 6-8 cm. broad, branches 2-many flowered, spreading and 8-35 mm. long; pedicels with small ovate, herbaceous bracts at base and 2-15 mm. long; calyx somewhat glandular-pubescent, becoming 7-9 mm. long, unequally cut to below the middle with triangular to ovate herbaceous lobes; corolla bright bluish-purple, 3 cm. long, sparsely pubescent outside, tube about 8 mm. long, throat inflated and about 9 mm. broad; lower lip 3-lobed, spreading, 8-10 mm. long; upper lip mostly erect, 7 mm. long; stamens included, all glabrous; anthers horseshoe-shaped, sinus coarsely long-villous, slit of dehiscence confluent over the proximal ends of the sacs and extending to below the middle on the outer sides, slit ciliate with subulate processes; capsule ovate, mucronate, body 8-10 mm. long; seeds irregularly prismatic, dark brown, closely tuberculate.

Type locality: Fort Tejon or vicinity. Type seen.

Occurring on dry slopes in the Upper Sonoran and Lower Transition Zones of the northern part of our region, as: Tehachapi Mts!, **Abrams & McGregor 304** and **445** (DS, GH), **Davidson 1688** (Davidson Herb.), **Hall 6268** (DS); Frazier Mt!, **Hall 6609** (DS); and Cuddy Canyon!, Mt. Pinos, **Dudley 4493** (DS). The locality, "Los Angeles," cited by Gray (Bot. Cal. 1:561. 1876) which is vouched by a specimen at Gray Herbarium, is probably the result of mislabeling, the locality name being used very loosely by Gray.

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DESCRIPTION OF MIOCENE FISHES FROM SOUTHERN CALIFORNIA

BY DAVID STARR JORDAN

In a recent visit to the noted diatom beds at Lompoc, Santa Barbara County, California, by Mr. Eric Knight Jordan, three new species of fishes were discovered, in addition to the fifty or more already secured from the same locality. In obtaining these, the collector is especially indebted to Mr. Edward B. Starr, director of the Celite Products Company. "Celite" is the trade name for these masses of pure diatoms used as blankets for hot pipes and, when crushed, as filtering substance.

Family CLUPEIDÆ

DIRADIAS Jordan, new genus

Type **Diradias aratus** Jordan.

This genus is not remote from **Clupea, differing** mainly in the very deep grooving of the opercle, the stronger serrations of the belly, agreeing in the number of vertebrae (deipas, a ridge).

1. **Diradias aratus** Jordan, new species.

Type No. 600, Stanford University, one specimen 14½ inches long, with caudal; cotypes 600A, counterpart of No. 600; and No. 601, 11 inches long, all these from the Miocene Diatom deposits at Lompoc, California. Collector, Eric Knight Jordan. The specimens are imprints, in fair condition, the type specimen having lost the ventral fins, and all of them with the head much injured.

Head 3 in length to base of caudal; depth 3¾; dorsal rays about 12, the longest 2 2/3 in head, pectoral rays about 10, the fin 2 2/3 in head;; anal mostly lost, its rays probably 20 or more; ventrals 3¾ in head; caudal rays 15+15=30, the lobes 1 1/10 in head; vertebrae 52 (apparently only 46 in No. 601).

Body moderately elongate, herring-shaped; head large and deep, the mouth-bones displaced, its cleft apparently very oblique, the jaws not long, the mandibular joint being below eye; no teeth preserved; eye moderate, well forward; cheek region apparently deep, as in **Alosa.** Opercular bones very deeply and coarsely ridged and grooved, the furrows most distinct on anterior part of opercle where there are about 10 short ridges, those before and behind less prominent; the main ridges vertical, stronger, diverging below, some sharp striæ on other bones of head, those on upper next to opercle branching.

Vertebræ deeper than long, rather weak, each with 2 or 3 deep furrows. Ribs numerous, very slender, many of them branched. Neural and hæmal spines short and slender; interneurals and interhæmals very feeble, mostly obliterated.

Pectoral fin placed low, of very slender rays, apparently not elongate; ventrals inserted under last rays of dorsal, obliterated in the type, a few weak rays shown in No. 601, its insertion at a distance behind gill opening about 4/5 length of head.

Dorsal fin short and rather low, the rays broken, its insertion at a distance behind head equal to 2/3 length of head, the fin probably a little higher than long, its interneurals short and slender; anal of slender rays, mostly obliterated. Caudal nearly as long as head, deeply forked, its outer rays about twice the inner.

Scales rather large, smooth, cycloid, some with the surface faintly striate. Edge of belly with strong serrations in the type, these largely obliterated in the others.

From other herrings of the Miocene, this species is well separated by the very strongly ridged opercle.

PLATE F.

Diradias aratus, Jordan
(Type) Lompoc.

Family HIPPOGLOSSIDÆ

HIPPOGLOSSUS Cuvier

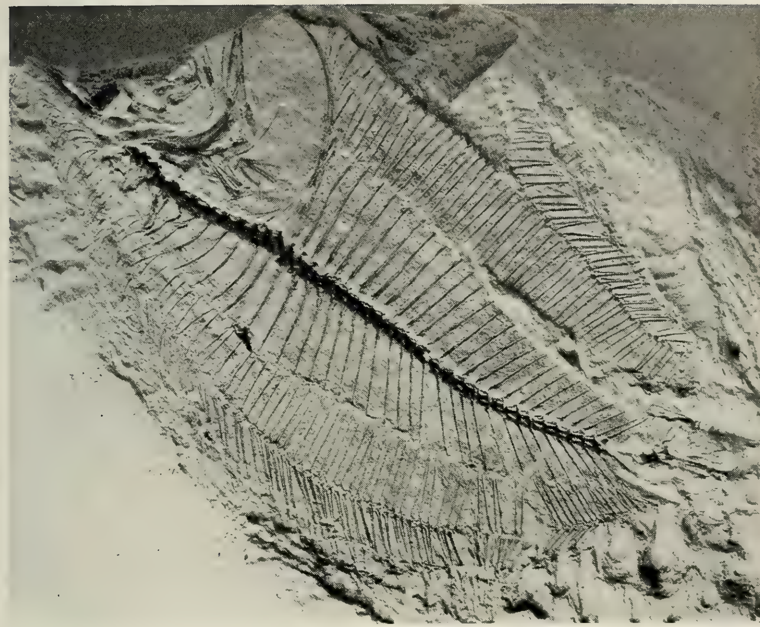
2. **Hippoglossus antiquus** Jordan, new species.

Type No. 603, a large fish, 21½ inches long from the Miocene Diatom deposits at Lompoc. Collector, Eric Knight Jordan. The type has the body well preserved, but lacks the most of the head, and the posterior part with the caudal fin.

Head about 3 1/3 in length; depth 2 3/8; ninety dorsal rays evident, probably about 3 others making 93 in all. Anal rays 49+5= about 54: vertebrae about 50, with rudiments of 8 to 10 more along top of head. Body broad, elliptical (whether dextral or sinistral cannot be ascertained). Head probably large, with large mouth (only the opercular region and top of head preserved). Abdomen short and deep, the ribs very feeble, about 8 preserved, the last bounding rib very strong, without spine at the lower end. Shoulder girdle broad, with prominent ridges; a rounded obtuse angle at base of pectoral. Pectoral short, of about 15 slender rays; ventral obliterated. Dorsal fin beginning well forward on head, probably over eye, its first rays low and slender, these progressively longer to behind middle of body, where the longest is about one third greatest depth of body. Anal similar, beginning well forward, 90 dorsal rays counted, perhaps 3 more obobliterated posteriorly; 50 anal rays counted with perhaps 75 more (=55) lost; hypural bone rather strong; caudal fin entirely lost.

Vertebrae deeper than long, each with about 4 deep furrows. Two interspinal bones, each with one ray for each neural or hæmal process, these strong, straight, except under anterior rays of dorsal, where the neurals and interneurals are slender and curved; hæmal bones longer and stronger than neurals; interneurals and interhæmals corresponding to increased height of rays.

This fish is evidently allied to the halibut, **Hippoglossus hippoglossus** and no character appears by which it can be separated from that genus. The numbers of vertebræ and fin rays would seem to separate it from **Paralichthys.** Until we can find out whether the fish was dextral or sinistral, what is the character of the mouth parts, where the dorsal fin begins and whether the caudal fin was lunate or convex, we may refer the species to **Hippoglossus.**



Hippoglossus antiquus, Jordan
(Type) Lompoc.

Family SPARIDÆ

ERIQUIUS Jordan, new genus

Type **Eriquius plectrodes** Jordan.

This genus seems closely allied to **Stenotomus, Lagodon** and other genera having an antrorse dorsal spine; it differs from these mainly in the form of the short and deep body and increased number of vertebrae (larger than in any living Sparoid fish), the teeth being unknown.

ERIQUIUS PLECTRODES Jordan, new species

Type No. 602, 12 inches long, in fair condition except for the crushed head and damaged fins. Diatom beds at Lompoc, Eric Knight Jordan collector.

Head 2 2/5 in length to base of caudal; depth 2; dorsal rays apparently XII, 14; anal rays about III, 10. Pectoral 15; ventrals I, 5; caudal 10+10=20. Vertebrae about 8+18=26.

Body very short, deep, compressed, the back elevated anteriorly. Head large, badly broken; preopercle high, slightly curved; one displaced premaxillary rather short, with a few short, marginal teeth.

Vertebræ rather weak, deeper than long, more numerous than in living **Sparidæ, each** with two deep grooves; ribs rather strong, about

Eriquius plectrodes, Jordan
(Type) Lompoc.

10 in number; neural spines strong, bearing long interneurals under the dorsal spines, these not winged; interneurals of the soft rays growing shorter and very slender backward; first interneural large, bearing a strong procumbent spine, as in **Stenotomus and Plectrites.**

Dorsal fin with rather strong spines anteriorly, these not greatly elevated, the number apparently 12; fin not notched, longest spines about half head. Anal inserted under last dorsal spines, the anterior interhæmals strong, the others rapidly shorter and more slender; the soft rays also slender. Anal spines short, subequal, the second a trifle longest, not enlarged. Caudal lunate, the lobes 1½ in head, the inner rays ¾ the outer.

Pectoral fin of slender rays, little more than half head; ventrals inserted just below pectorals nearly half head.

Some scattered scales of moderate size, nearly smooth; some of them with the inner margin crenate, but these may belong to some other fish.

Family CYPRINODONTIDÆ

PARAFUNDULUS Eastman

4. **Parafundulus erdisi** Jordan, new species.

Type No. 605, Stanford University, from confluence of Liebre and Piru Creeks, Section 3, Township 6 N. R. 18 W. in the Santa Barbara National Forest, in the northern part of Los Angeles County, California; elevation 2,200 feet. Collector, Ellwood C. Erdis, of El Paso, Texas. Cotypes (606: 607) same locality.

Head 4¼ in length to base of caudal; depth 4 2/3. Dorsal rays 10 (12) anal rays 10 (12 in 607); caudal rays about 16 (20 in No. 606); ventrals apparently wanting, present in No. 606; pectoral rays 10; vertebrae 14+20=34, (length, with caudal, 3 inches, No. 606, 4 2/3 inches).

Parafundulus erdisi, Jordan
(Type) Libre Creek, Los Angeles, County

The larger example, No. 606, is evidently the same, but the parts are more obscure. 20 caudal rays may be counted. Ventrals present, fairly large, the rays 5 or 6. A third example (607) shows a vertebral column with the anal fin of 12 rays.

General form of **Fundulus**, moderately elongate, and somewhat compressed. Head entirely crushed; no bones clearly to be made out, the mouth appearing rather small. Pectoral moderate, inserted low. No trace of ventral fins in the type example, evident however in No. 606; dorsal and anal each rather short, not elevated, about equal, the insertion of the dorsal a little in advance of that of the anal, the anal extending a little farther back; caudal not produced, its outline rounded, its middle ray longest. Vertebrae deeper than long, each with three ridges and grooves; the ribs and spinal bones fairly developed, the interspinals slender, a few scattering scales of moderate size traceable.

The three specimens were obtained by Mr. Erdis in a black, slaty rock supposed to be relatively recent formation. As usual when the head is all intact, the bones are obliterated, a fact which may be due to fats or other substances within the brain, as when detached from the brain and jaw bones, opercles and the like are very often well preserved.

I am indebted for this material to Mr. George F. Eaton, Secretary of the Connecticut Academy of Arts and Sciences. From a letter of Mr. Erdis transmitting the specimens to New Haven, I quote:

"The specimens are from the junction of La Liebre (Jack-Rabbit) Creek, with Piru Creek. The geologic maps call the locality "Dry Lake." The shale formation is about 10 miles north and south and (I think) half that in width. The whole country has been heaved, folded, bent and broken, and all other descriptive terms of severe physical contortions of Mother Earth. I have seen two different cliffs

PLATE J.

Parafundulus erdisi, Jordan

half a mile apart which show the strata bent at right angles, with the fracture from six inches to two feet wide. Some of the meanest oak brush and chapparral you ever saw. . . . Geologically it is recent, for the cliffs and hills are sharp, and entire mountain sides will have only two to six inches of broken shale on the surface not enough to support a growth."

The type specimen may have lost its ventral fins, or it may never have had them. In some of the living desert species of **Cyprinodon (C. baileyi, C. browni)** the ventral fins are often much reduced or in **C. baileyi** entirely absent. It may be so with other desert **Cyprinodonts.**

The species agrees in essential respects with **Parafundulus nevadensis** Eastman, lately described from Lahontan beds near Hazen, Nevada. **P. erdisi** has the dorsal fin less advanced, and it is probably of later age, though this is not certain. **Empetrichthys merriami** Gilbert, from the Amargosa-Death Valley region, has no ventral fins, but is otherwise quite unlike **Parafundulus.** It has probably no relation to **Orestias,** a South American genus lacking ventrals with which it has been compared.

Family SCIÆNIDÆ

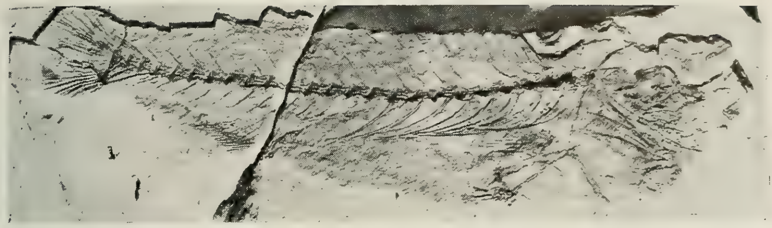
LOMPOQUIA Jordan and Gilbert

5. **Lompoquia retropes** Jordan and Gilbert.

Lompoquia retropes Jordan and Gilbert, (J. Z.) Fossil Fishes S. Cal., 49. Pl. XXIV Fig. 1, 1919 (Lompoc); Jordan, Fish Fauna Cal. Tertiary, 281. Plate 47 (restoration) same specimen.

Of this species, heretofore known from an imperfect example, we have received a fine specimen from Miocene shales at Covina, California, from Mr. Morris Goodwin of the Featherstone Insulation Company, through the courtesy of Dr. James Z. Gilbert.

PLATE K.



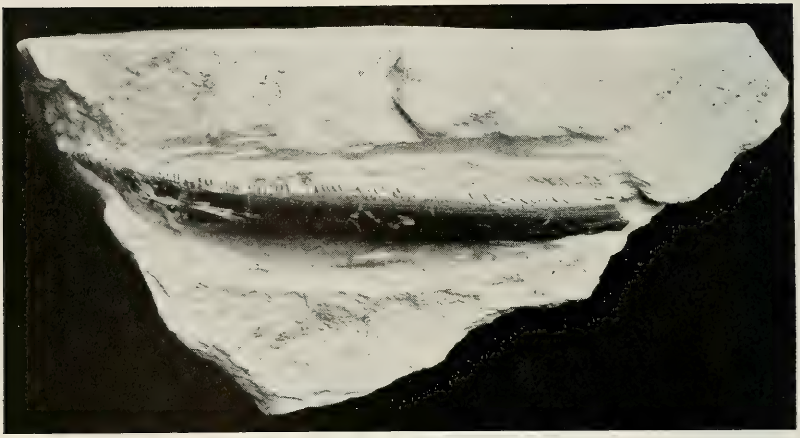
Lompoquia retropes, Jordan and Gilbert
Covina

Length 8¾ inches. Head crushed, first dorsal obliterated; otherwise in fair condition, in a rather hard sand-shale.

Body oblong, compressed, the dorsal outline nearly straight, the ventral more curved. Head large, about 4 in length; its bones entire; mouth and teeth. Vertebrae 10+14=24, besides the small hypural, the segments rather strong, longer than deep throughout, slightly constricted, each with two strong ridges and grooves; neurals rather slender, rather largest mesially; hæmals quite similar. Interneurals short and slender, not winged nor dagger-shaped, not expanded at base, about as long as the neurals, decreasing rapidly backward; interneurals of the soft dorsal much weaker than the neurals and set more obliquely; one for each pair of neurals under the spinous dorsal; two under the soft dorsal. Interhaemals small and weak, shorter than the hæmals, that supporting the second anal spine, slender but longer and stronger than the others; two interneurals to each pair of hæmals. Ribs rather long, slender, curved backwards. Opercles convex.

Spinous dorsal lost, represented by 12 interneurals, the spines probably weak. Soft rays slender, not to be exactly counted, the fin apparently XII-1, 12; no traces of any more, either as rays or interneurals; 10 vertebrae below spinous dorsal, 5 below soft dorsal. Anal rays apparently II, 16, the rays slender; the fin longer than the soft dorsal, and beginning under its middle; its spine (1 or 2) relatively weak and broken, inserted under middle of the soft dorsal; the soft rays low, crowded; (both dorsal and anal may have had more rays in life). With the anal are obscure traces of more interneurals indicating 20 soft rays. Caudal probably lunate, the subtruncate hæmals divided, three strong rays on either side supported by stout elements from the last three vertebrae. Ventrals (I, 5) inserted well behind the pectorals, the pelvic bone unusually long, the insertion near middle of the pectoral length. Pectoral unsymmetrical, of moderate length. Small scales seen at intervals, these entire or slightly crenate.

This fish is evidently identical with the type of **Lompoquia retropes,** the backward ventrals, the weak fin rays and the form of the vertebrae leaving no doubt. Its number of vertebrae indicates a typical member of the **Sciænidae** (not an ally of **Otolithes**, as at first supposed). With the living California genus, **Seriphus,** it has some-



Deprandus lestes, Jordan and Gilbert
Alhambra

thing in common, the anal being apparently longer than the soft dorsal. This relation does not appear in our restoration of **Lompoquia retropes,** the original type lacking the posterior region of the body. But **Seriphus** has the vertebrae 14+10, as in **Cynoscion** and **Otolithes. Lompoquia** is certainly 10 or 11+14 or 13=24 in all.

Family DEPRANDIDÆ

DEPRANDUS Jordan and Gilbert

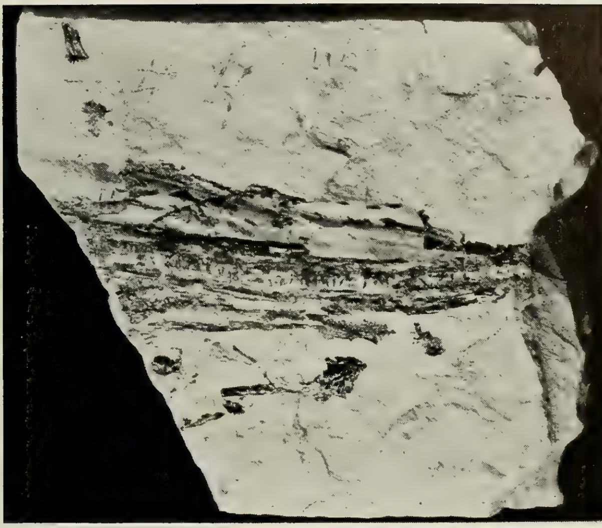
6. **Deprandus lestes** Jordan and Gilbert.

Deprandus lestes Jordan, Fish Fauna of the California Tertiary, 1919, 252. 1921. Plates 9b; 30b; El Modena; Alhambra.

This species was originally based on two examples from El Modena. These are quoted in the paper above named as having been described in the Proceedings of the Natural History of Southern California, but the account prepared by Dr. Gilbert referred to still remains in Manuscript.

The specimens from Alhambra referred to above differ slightly from the types from El Modena. They agree with two jaws from Alhambra since loaned to us by Dr. A. J. Tieje of Los Angeles. These we (Jordan and Gilbert) describe as follows:

The first is a fragment of skull, upper and lower jaws, mouth closed. Length 2 inches, slender, feebly curved upward, closely set (25 to inch) with uniformly conical, sharp teeth at intervals slightly greater than the width of the tooth at base; the row double except in the very front where small teeth seem set among teeth of twice



Deprandus lestes, Jordan and Gilbert

their size; those toward the middle and posteriorly feebly stouter; curved inward and feebly forward. In addition to this regular outer row of about 50 teeth is another of slightly smaller teeth alternating with those of the outer row.

Length of second fragment 3 inches, straight except at the anterior fourth where it is curved slightly upward; set with a double row of teeth, sharp pointed, strong, conical curved inward and all directed strongly forward. The teeth of the outer row (judged by the bases clearly seen) more numerous than in inner (30 to the inch, inner 22 to inch) about 55 in all; along the middle larger, at posterior part shorter and more slanting, anterior teeth very small. No elongate canines.

We are not quite sure that these belong to **Deprandus lestes.** The extraordinary length and slenderness of the jaw in **Deprandus** justifies the recognition of a distinct family, **Deprandidæ,** which may prove to be related to the **Murænesocidæ** rather than to the **Murænidæ.** Stanford University, February 9, 1924.

STUDIES IN PACIFIC COAST LEPIDOPTERA

DR. JOHN A. COMSTOCK

NEW RACES OF CALIFORNIA BUTTERFLIES

In the preparation of material for the author's forthcoming book on the Butterflies of California, a number of interesting varieties have been separated that are deserving of designations. A preliminary description of these will be recorded in this publication, to be subsequently followed by colored illustrations.

EUCHLOE AUSONIDES Bdv. flavidalis, var. nov.

This is a color form of **ausonides** in which a yellow suffusion covers the upper surfaces of both primaries and secondaries. It may be described in detail as follows:

UPPER SURFACE.

Primaries, ground color light yellow. Costae, yellow mottled lightly with dark scales. Apices marked with grey brown spots of oval form occuring in relation to the nervules and constricted at their outer and inner edges. On the upper and lower radial and third median veins these spots are continued inwardly to their junction with a broad submarginal dark band, the latter extending from costae to third median vein. A dark dash marks the outer termination of second median vein. Fringes alternately grey and yellow, the grey scales in relation to the marginal row of spots. An irregular semilunate black dash at outer edge of cell. Basal area shaded inwardly with grey scales.

Secondaries. Ground color yellow, of a slightly darker shade than primaries. Ends of all nervules slightly accented by grey scales, the color continuing out to the fringes, Basal area heavily shaded with grey. The entire surface of the secondary has a slightly transparent effect allowing the green mottlings of the under surface to show through as delicate shadings.

UNDER SURFACE.

Primaries. Ground color yellowish white, except at apices which are pure white. Costae and outer extent of all nervules dark yellow. A concentration of this dark yellow color occurs in the region of the submarginal dark band (of upper surface) dark dash at outer edge of cell nearly as marked as on upper surface.

Secondaries. Ground color yellowish white, venules dark yellow. Irregular blotching and mottling of wing with olive green as in other closely related forms, but somewhat heavier than in typical ausonides. Antennae dark grey tipped with yellow. Thorax and abdomen, grey, covered with long white pile. Legs, yellow.

Type. One ♀ collected by E. J. Newcomer at Palo Alto, California, May 23, 1905, in the Collection of the author, Southwest Museum. So far as I know this form occurs only in the female.

EUCHLOE AUSONIDES. Bdv. Semiflava, var. nov.

This form is marked practically as the above except that the upper surface of the secondaries alone shows the yellow suffusion, and the greenish mottling on the under side of secondaries is less extensive.

Type. One ♀ San Jose Mission, California, April, 1919. Collection of the author, Southwest Museum.

It is justifiable, in our estimation, to name these forms in view of the fact that they show a tendency within the genus toward a dimorphism of the females. An illustration of the types of above two color forms will be published in our forthcoming plate X, Butterflies of California.

ANTHOCHARIS REAKIRTI Edw. Wrighti aberr. nov.

This remarkable aberration of reakirti probably represents a case of melanism, in which the dark markings of reakirti are carried to the ultimate degree. It was submitted by our friend W. S. Wright of San Diego, for whom it is named.

UPPER SURFACE.

Primaries. Ground color white, heavily shaded with black in the basal area and along the costae. All of the outer half of the wing from a line drawn diagonally across the outer edge of cell to inner angle is black, with the exception of a few orange-red scales, centrally placed in the black area.

Secondaries. Ground color white, profusely sprinkled with black scales. Basal area heavily shaded with black. Venules heavily and widely margined with black in the limbal area, giving the wing a striated appearance. This black banding is extending onto the fringes.

UNDER SIDE.

Primaries. Costae finely mottled with black, more heavily concentrated in the apical region. Cell, basal and discal area white, venules beyond the outer edge of cell heavily margined with grey leaving only minute striations of yellow in the interspaces. The orange colored area of typical reakirti has practically disappeared except for a minute line in the radial interspaces. The outer portion of apex has a greenish appearance, due to the admixture of the yellow and grey scales.

Secondaries. Much as in **reakirti** except for a heavier concentration of the mottled areas.

Body and antennae as in typical **reakirti.**

The type is figured on plate XI, figure 16, of our series, "Butterflies of California," to be subsequently published. It was taken by S. W. Monroe, at Chula Vista, California, March 7, 1919.

BUTTERFLIES OF CALIFORNIA

By DR. JOHN A. COMSTOCK

Continued from January-February Issue

THE WHITES AND ALLIES

Family PIERIDÆ

Genus PIERIS

The Common White. Pieris protodice, Bdv. and Le Conte, (plate VII, figure 14, 15, 16, 17) is our most abundant Pierid with the single exception of rapae. It is found throughout the entire state. In flight it is more vigorous than the cabbage butterfly. The early spring brood, emerging from overwintering pupae, is more distinctly marked, with a greenish penciling on the under surfaces, and, in the female, a reduction and intensification of the markings on the upper surfaces.

This variety has been given the name of **Vernalis.** (Plate VIII, figures 2, 3, and 6.) Protidice is a species of some economic importance as its larvae feed on cabbage and nasturtium. More commonly it may be taken on mustards.

This species, in common with most butterflies is variable in size, and dwarfs or giants are not uncommon. Two of these interesting dwarfs of P. protodice are shown on Plate VIII, figure 1 and 4. They probably are the result of semi-starvation of the larvae.

The Western White. Pieris occidentalis, Reak. (Plate VIII, figures 5, 7, and 10) represents a western, high altitude race of the former species which is occasionally taken in our mountains. It is distinguished from protodice principally by the heavier and more greenish markings on the under side of secondaries. This form also has an early spring race, characterized by its smaller size and intensification of the dark markings, which has been named **calyce.** (Plate VIII, figures 8, 9, 11.) The larvae feed on various species of mustards.

LILIUM PARRYI var. Kessleri, n. var.

A. DAVIDSON, M. D.

The shape of the bulb, character of the scales, the general habit and color of the flowers are the same as in the type but the leaves are large, ovate-lanceolate, 12 to 15 cm. long and 4 cm. wide, sessile with a narrow base, thin in texture, semitransparent on drying and glistening on lower surface; leaves below in whorls of 6, fewer and less definitely whorled above; anthers brown, 5-7 mm. long; pistil much longer than the anthers.

Type No. 3586. Collected by Robert Kessler at the upper end of Little Rock Creek, San Gabriel Mts., Sept., 1923.

This is the common form of the San Gabriel Range and grows very abundantly in the type locality and on Soldiers Creek in the same district. The marked difference in the shape and quality of the foliage, the coarser quality of the flowers, the smaller anthers and protruding pistil almost warrant giving it specific rank.

PLATE M.

Lilium parryi var. Kessleri
Davidson

THE MARINE FISHES (TELEOSTEI) OF SOUTHERN CALIFORNIA†

BY ALBERT B. ULREY

Director of the Marine Biological Station of the University of Southern California

and

PAUL O. GREELEY

Instructor in Biology, University of Southern California

The data on which the following papers are based was secured chiefly during the dredging and trawling expeditions of the Marine Station launch, the Anton Dohrn. The explorations made with the launch began in 1911 and have been continued at irregular intervals to the present. A brief general account of this work was published in the Bulletin of the Academy of Sciences of Southern California, January 1917 and in six Bulletins of the Marine Biological Station of the University of Southern California.

The general plan of these studies of Southern California Fishes includes (1) A detailed study of certain groups of our fishes; (2) Studies on certain economic problems; (3) The distribution of the forms known to occur here; (4) The preparation of keys to facilitate the identification of our groups of fishes.

For our convenience the keys have been prepared first. Then the general distribution of all the forms known to occur in Southern California has been summarized. Relating to the species taken in our survey the distribution is given somewhat in detail.

The insistent request of the public for common names of our fishes makes it seem desirable to include some of the common names of species with some particular interest. As it is well known that there is no uniformity in the use of these common names. It has seemed

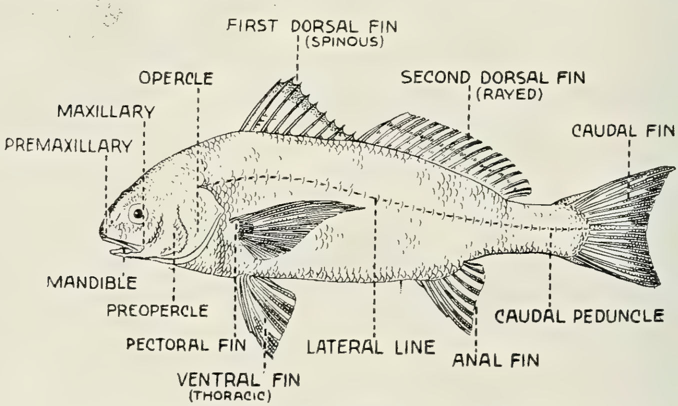


Fig. I RONCADOR STEARNSI (RONCADOR)

FAMILY - SCIAENIDAE

†Contributions from the Marine Biological Station of the University of Southern California.

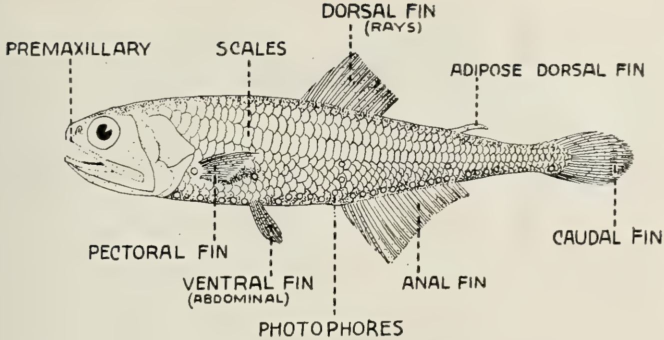


Fig. II. **TARLETONBEANIA TENUA**

FAMILY - MYCTOPHIDAE (LANTERN FISHES)

to us desirable to use the common names published in the standard works on the fishes of the West Coast as far as feasible, deviating from this rule only in cases in which the name is manifestly misleading. The preferred name is placed first, then parenthesis for other names and quotation marks for names used which are misleading.

The study of our collections of fishes has been made largely by graduate students and teaching fellows in the Department of Biology of the University. Mr. Frank W. Yocom formerly in charge of the Anton Dohrn has identified many of the species taken and has contributed largely to the compilation of data. The identifications of our entire collection have been verified by Henry W. Fowler of the Academy of Natural Sciences of Philadelphia.

The four large volumes by Jordan and Evermann on the "Fishes of North and Middle America" still remains the standard work for the study of the fishes occurring in Southern California waters. The key to the families of fishes described in these volumes has been adapted to the identification of the more limited groups of marine fishes off the coast of Southern California. The use of this modified key obviously reduces greatly the labor of identification. The names of families in brackets are those found in Jordan's "Classification of Fishes" 1923.

Other keys aiding in the identification of our fishes will be found in the large volume by Jordan and Everman on "American Food and Game Fishes" and in Fish Bulletin No. 5 of the California Fish and Game Commission 1921A: "A key to the Families of the Marine Fishes of the West Coast" by Edwin C. Starks.

A KEY TO THE FAMILIES OF MARINE FISHES (TELEOSTEI) OF SOUTHERN CALIFORNIA

1. **Ventral Fins Present, Abdominal.**
   - A. Back with adipose fins, dorsal fewer than 20 rays; body scaly.
   - B. Photophores absent.
   - C. Head naked; branchiostegals 6-20.
   - D. Stomach and many pyloric cæca............. **Salmonidæ.**
   - DD. Stomach with few pyloric cæca............ **Argentinidæ.**

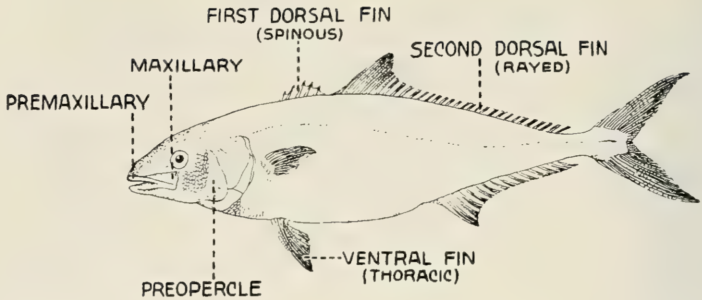


Fig. III. **SERIOLA DORSALIS** (YELLOW-TAIL)
FAMILY - CARANGIDAE

CC. Head scaly on sides; maxillary very narrow, rudimentary or obsolete .... **Synodontidæ.**

BB. Photophores developed; no barbels at throat; vertebral spines not exserted in front of dorsal.

E. Pseudobranchiæ present.

a. Form elongate, snout pointed, photophores small .... **Paralepididæ.**

aa. Form oblong, snout not much produced, photophores conspicuous .... **Myctophidæ.**

EE. Pseudobranchiæ absent; mouth large, with canine teeth; scales deciduous or wanting .... **Chauliodontidæ.**

AA. Back without adipose fin.

B. Back with a single dorsal fin made up of rays and not preceded by a series of free spines or followed by finlets.

C. Body naked; throat without barbel; pectorals wanting; body snake-like; dorsal long and low..... **Idiacanthidæ.**

CC. Body scaly.

D. Anal fin without distinct spines.

E. Pectoral fins inserted high, near axis of body.

F. Jaws each with long, sharp teeth mixed with smaller ones .... **Escocidæ [Belonidæ].**

FF. Jaws with small equal teeth, conic or tricuspid.

G. Lower jaw more or less produced....... **Hemiramphidæ.**

GG. Lower jaw a little produced; teeth conic; pectorals elongate, forming an organ of flight........... **Exocoetidæ.**

EE. Pectoral fins inserted below axis of body.

H. Throat with long barbels. Sides with phosphorescent spots .... **Stomiatidæ.**

HH. Throat without barbels.

b. Phosphorescent spots present; teeth unequal........... .... **Chauliodontidæ.**

bb. Phosphorescent spots none.

I. Head scaly, more or less.

c. Maxillaries connate with premaxillaries; jaws long...... .... **Synodontidæ.**

cc. Maxillaries distinct; upper jaw protractile, its margin formed by premaxillaries alone; no lateral line....... .... **Poecilidæ.**

II. Head naked.

J. Dorsal fin inserted more or less before anal (rarely slightly behind it); shore fishes or river fishes, usually silvery in coloration with skeleton firm.

K. Gular plate none; lateral line well developed; mouth small, horizontal; teeth present; posterior part of tongue and roof of mouth covered with coarse-paved teeth. **Albulidæ.**

KK. Lateral line wanting; no gular plate.

L. Mouth moderate, terminal, maxillary about three pieces. .... **Clupeidæ.**

LL. Mouth subinferior, below a tapering, pig-like snout, maxillary very long............................**Engraulidæ.**

JJ. Dorsal fin posterior; opposite anal; deep-sea fishes; mostly blackish, mouth small, with small pointed teeth...... .... **Alepocephalidæ.**

BB. Dorsal fin single, preceded by free spines.

M. Body scaleless, naked or with bony plates.

N. Ventral fins I, 1. The spine strong; snout moderate..... .... **Gasterosteidæ.**

NN. Ventral fins I, 5, the spine slender; snout prolonged. .... **Aulorhynchidæ.**

BBB. Dorsal fins 2, the anterior of spines only, the posterior chiefly of soft rays.

O. Pectoral fin with 5 to 8 lower-most rays detached and filamentous. ....**Polynemidæ.**

OO. Pectoral fin entire; snout not tubular.

P. Teeth strong, unequal, lateral line present. **Sphyrænidæ.**

PP. Teeth small or wanting, lateral line obsolete.

Q. Dorsal spines 4, stout; anal spines 3...........**Mugilidæ.**

QQ. Dorsal spines 4 to 8, slender; anal spine single....... .... **Atherinidæ.**

BBBB. Dorsal fin soft-rayed, followed by a series of detached finlets ....**Scombresocidæ [Scomberesocidæ].**

2. Ventral Fins Present, Thoraric or Subjugular, the Number of Rays Definitely I, 5.

A. Gill openings in front of the pectoral fins.

B. Body more or less scaly or armed with bony plates. (BB near end.)

C. Ventral fins completely united; gill membranes joined to the isthmus; no lateral line..................**Gobiidæ.**

CC. Ventral fins separate.

D. Suborbital with a bony stay, which extends across the cheek to or toward the preopercle, cheeks sometimes entirely mailed.

E. Pectoral fin with 3 lower rays detached and free; head bony ....**Triglidæ.**

(To be continued in the May-June Number of the Bulletin

NOTES ON APHIDOPHAGOUS SYRPHIDÆ OF SOUTHERN CALIFORNIA

——By——

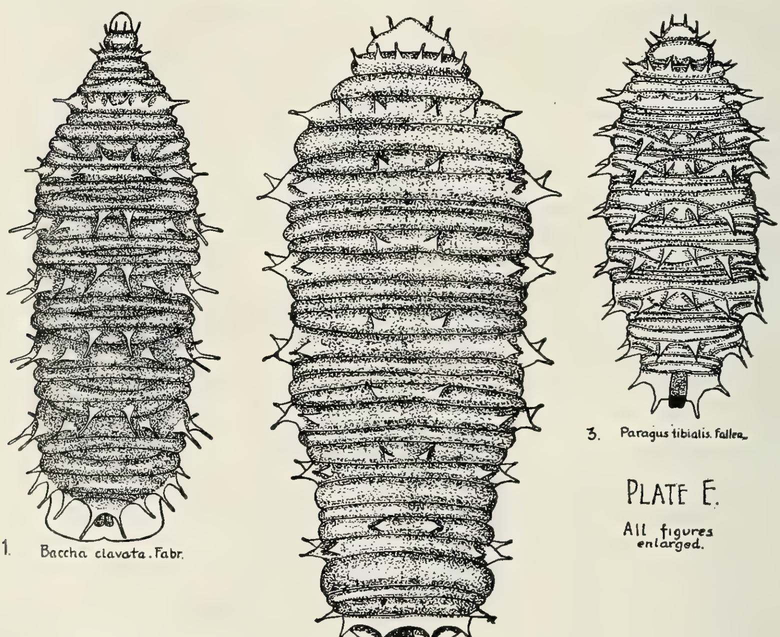
ROY E. CAMPBELL AND W. M. DAVIDSON
U. S. Bureau of Entomology

(Continued from January-February Issue)

ALLOGRAPTA OBLIQUA Say.

This species ranks very close to **Eupeodes volucris** in abundance. In fact, during the summer season, and on such hosts as the melon aphis, it is much more abundant than **Eupeodes,** but although it can be taken during any month in the year, it fails to maintain itself in such numbers during the winter.

A. obliqua is one of the smaller elongate species, the adults being from 6 to 8 mm. long. They are bright-colored and iridescent in the sunlight. The male has large bright red eyes, while those of the female are brownish red. General characters: Face yellow, with a facial stripe variable in extent and boldness, generally fading from center laterally; color brown. Thorax deep shining green, with yellow or light orange lateral stripes. Scutellum gamboge, with black pile. Abdomen brownish black: First segment, except a slender transverse spot on each side behind, yellow; second segment with a slender yellow anterior fascia, and a broader one in the middle; third segment with a broad, arcuate yellow band; fourth segment with two slender parallel stripes, leaving a slender black stripe between them, on each side a broader, oblique, oval spot, touching or



1. Baccha clavata. Fabr.

2. Eupeodes volucris. O.S.

3. Paragus tibialis. Fallen.

PLATE E.

All figures enlarged.

PLATE N.

narrowly separated from the anterior end of the yellow longitudinal stripe, and reaching to the posterior angles; fifth segment similar, but side spots less oblique.

The egg is elongate oval, .8 mm. long, .3 mm. in diameter; chalk-white, elevations of the chorion 3 or 4 times as long as broad, elevations about two-thirds as wide as the interstices.

The incubation period varies from 2 to 3 days in summer up to as long as 8 days in mid-winter.

The newly-hatched larvae are pale-yellow, almost white, apparently devoid of vestiture, .85 to 1 mm. long by .2 to .35 mm. wide. As growth proceeds the color slowly deepens until toward the end of the penultimate instar a greenish hue is visible, and after the final molt the color is bright green.

Full-grown larvae are 10 mm. long and 2.5 mm. wide; general color pea green, somewhat lighter at sides and anterior end. The broad whitish-green median stripe, with narrow darker heart line showing through, in some specimens gives the appearance of a double stripe. Body somewhat flattened, especially so at posterior end, wrinkled; segments showing indistinctly. Segmental spines short, white, inconspicuous. Posterior spiracular tubes prominent, 1 mm. long, a fused pair, divergent at tips, length twice as much as combined width; color light brown. In some specimens the dorsal line shows pinkish or reddish. The general appearance of **Allograpta** larvae is comparatively smooth and slug-like.

The larvae grow rapidly under favorable conditions, and require only from 9 to 15 days to complete their development. During summer and fall the average period of development is only 9 or 10 days. During mid-winter, however, the development is slow, and the larval stage is from 16 to 21 days.

Allograpta larvae feed greedily, as the following food records will show: 174, 188, 184 **Aphis gossypii** (stages ii-v); 124, 155 and 188 **Aphis gossypii** and **Chromaphis juglandicola** (all stages); 210, 228 **Myzus persicae** (stages i-iv); 205 **M. persicae** (alates).

However, larvae can mature on much fewer aphids, as the following records show: 57 **Aphis brassicae** (all stages); 79 **Macrosiphum rosae** (stages i-iv). Also a lack of food prolongs the larval stage. Thus three larvae hatching at the same time had daily access, for practically their entire life, to the following number of aphids: 4, 8 and up to 38 Myzus persicae (stages iii-v). The first one consumed a total of 132 aphids and matured in 39 days; the second ate 154 and

In confinement larvae readily ate the mealy bug **Pseudococcus citri** Risso, but refused the red spider, **Tetranychus telarius** Linne. They were not reared successfully on **Aphis rumicis,** on several occasions being unable to free their jaws from this aphid.

Newly-hatched larvae maintained themselves on corn and beet foliage for three days without having access to aphid or other animal food. On the fourth day they were observed to have slightly grown, and aphids were fed them, whereupon they developed normally. Older but not full-fed larvae were able to transform after as long a fast as 5 days. A fast of 8 days did not kill them outright, but pre-matured in 34 days; while the third larva, which had daily access to abundant food supply, consumed 167 and matured in 16 days.
vented subsequent transformation. The fact that larvae can subsist for several days without aphids must be of considerable assistance to the species if the parent happens to oviposit where aphids are not immediately available, or where those present disappear before the egg hatches.

The larvae are better adapted to stand excessive moisture than are those of other species, such as **E. volucris, B. clavata** or **P. tibialis;** on the other hand they appear to succumb to drought more easily. The larvae seek out some dark locations, as curled leaves, along mid-ribs, and lie there when not feeding. On walnut trees they have a penchant for resting in the obscure locations at the base of a nut cluster. On these trees pupation occurs chiefly on the upper surface of the leaf, but also on the lower surface, petioles and nuts. Observations suggest that in the summer broods, pupation always occurs above ground. On melon vines, larvae congregate under the fruit at the soil surface to pupate, but many also pupate on the foliage. (Fig. 3a)

When first formed the pupa is bright pea green, the markings of the larva showing very distinctly. As development takes place the larval coloration is lost, and the puparium becomes a darker green with a brownish tinge. The anterior end is bulbous; the insect is broadest and deepest in front of the middle, the dorsum broadly rounded, tapering to a tip at posterior end; venter slightly concave. Posterior spiracular tubes prominent, 1 mm. long, and longer than their combined width, color light brown. Length 5.5 to 6 mm., width 2.5 to 2.75 mm.; height 2 to 2.5 mm.

A few days before emergence the bright reddish brown eyes and yellow striped abdomen of the imago show very plainly through the puparium shell.

In the summer the pupal stage varies from 8 to 10 days, while in mid-winter it requires from 18 to 33 days.

During the period June to November many attempts were made to induce adults to breed in confinement. Altogether 75 males and 92 females were employed in these tests, most of which occurred in large wire screen cages where the flies were provided with honey-bearing plants (Alyssum) and sugar-water. The flies were newly-hatched and lived in the cages for an average of 15 days, but not a single egg was deposited nor was copulation ever observed.

Nine gravid females were caught in the field and observed for egg-laying records. The maximum number of eggs was 173, deposited in 6 days on screened plants infested with aphids (July). In general thirty eggs and over were often deposited within 24 hours by these flies. More than 90 per cent of the total number (563) were fertile.

Judging from the habits of flies kept in captivity the adults move about but little before the sun is well up in the morning. At night they were observed resting on the foliage and cage sides and tops. The flies exhibit their greatest activity in full sunlight.

In the field the flies fed on blossoms, and have been observed on many varieties; in field cages they readily fed on alyssum; in captivity they readily lapped up and gorged themselves on honey water.

Out of 145 bred flies, 77 were females and 68 males.

The figures given above for the various stages show that the period from egg to adult varies from 19 to 25 days in summer, and from 42 to 62 days in winter. Indications are that there are from 6 to 8 generations per annum.

A. obliqua larvae have been taken feeding on the following aphids: **Aphis atriplicis** L., **A. gossypii, A. maidis, A. roseus** Baker, **A. medicaginis** Koch., **A. nerii** Fons, **A. pomi** DeGeer, **A. prunifoliae** Fitch, **A. rumicis, A. viburnicolens** Swain, **Brevicoryne brassicae, Chromaphis juglandicola, Macrosiphum cucurbitae, M. pisi, M. rosae, Myzocallis bellus** Walsh, **Myzus braggii, M. rosarum** and **Toxoptera aurantii.**

The internal parasites, **Diplazon laetatorius** and **Pachyneuron californicum** have been bred from puparia of **A. obliqua.**

In the fall of 1919 in Los Angeles and Orange Counties 84 larvae and puparia were collected and reared for parasite data. Of these but 4 yielded parasites, 1 **Diplazon** and 3 **Pachyneuron.** From the three puparia parasitized by the latter there issued respectively 6 females, 7 males and 5 females, 5 males and 3 females. The **Pachyneuron** imagoes emerged through single holes cut in the puparia shells of the hosts, while the single Diplazon cut a jagged hole in the operculum.

The record indicates a parasitism of about 5 per cent.

ALLOGRAPTA FRACTA O. S.

This species is very much like **A. obliqua,** except that it is a little smaller. The chief differences which enable the two to be separated are as follows: In **fracta,** there is a bluish-black facial stripe extending in the oral margin, while in **obliqua** it is brown. In **fracta** the first abdominal segment is not more than half yellow above, while in **obliqua** considerably more than half of the segment is yellow. The scuteelar pile of **obliqua** is all black, while in **fracta** it is almost all yellow. In **obliqua,** on the fifth segment of the female the longitudinal stripes are parallel, while in the **fracta** female they diverge anteriorly. The immature stages are practically indistinguishable.

For Southern California generally **fracta** is a much less common species than **obliqua,** but in the Imperial Valley **fracta** is very abundant and **obliqua** scarce.

The egg is white, microscopically sculptured, elongate oval, .85 mm. x .25 mm.

The incubation period varies from 2 to 3 days in the Imperial Valley and 5 to 6 days at Alhambra at about the same time of year.

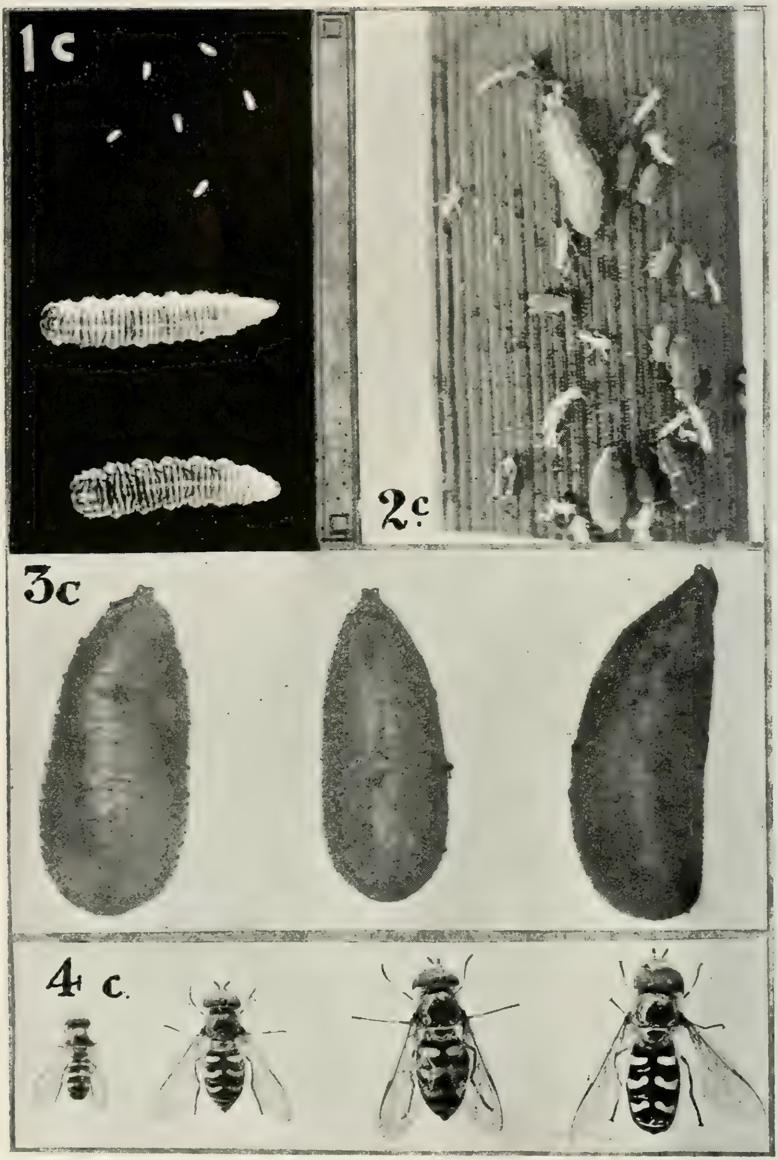
The newly-hatched larvae are whitish, narrow, cylindrical, the mouth parts gray; on each segment are two small fleshy conical elevations. The posterior spiracular tubes are light brown, wartlike, not contiguous.

As growth proceeds the body becomes pea-green in color. In younger larvae the dorsal strip has a pinkish tinge, but this gradually fades away.

The full-grown larvae are 8 to 9 mm. long, 2 mm. wide and 1.2 mm. in height, elongate oval, somewhat flattened. Integument papillose, transversely wrinkled; color green with two narrow whitish stripes flanking the dorsal vessel; posterior spiracular tubes prominent, .5 mm. long, about half as wide at bases.

The larval stage in the Imperial Valley in March was from 11 to 12 days, and at Alhambra 13 to 15 days in April and May and 25 to 27 days in February.

PLATE O.



Only two complete feeding records of **fracta** larvae were observed, as follows: 185 and 209 **Macrosiphum rosae,** stages i-iv.

Pupation takes place on the plant foliage. The puparia are green and at first show the larval markings. These gradually disappear and the eyes and abdomen of the adult begin to show. Anterior face of the puparium bulbous, outline of dorsum convex, curving downward toward the base of the respiratory tubes, venter gently concave. Length 5 to 6.5 mm.; width 2 to 2.5 mm.; height 1.7 mm. to 2.1 mm.

The duration of the pupal stage was 5 to 12 days at El Centro; 13 days in April and May, and 23 to 26 days in March, at Alhambra.

Breeding in confinement was not successful, although adults lived as long as 18 days. Two females captured in the field laid 52 and 60 eggs in 5 and 9 days respectively.

The length of life from egg to adult for this species varies from 18 to 27 days in the Imperial Valley (March-April), while at Alhambra it is from 31 to 34 days in April and May, and 53 to 59 days in February and March.

A. fracta larvae were taken on the following aphids: **Aphis gossypii, A. maidis, A. prunifoliae, Illinoia pisi, Macrosiphum rosae, Myzus rosarum, Toxoptera graminum, B. brassicae.**

From **A. fracta** have been bred the same parasites as from **A. obliqua.** In the spring of 1918 **Diplazon laetatorius** was bred frequently and **Pachyneuron californicum** occasionally in Imperial County.

CATABOMBA PYRASTRI L.

This species is also one of the common Syrphus flies. It is seldom quite as numerous as **Eupeodes or Allograpta,** but ranks about with the **Syrphus** species, which it closely resembles both in structure and appearance. It is common during the cooler parts of the year, being most abundant in the spring and fall, and scarce during June, July and August.

The adult is the largest of our aphidophagous Syrphids, being from 11 to 13 mm. in length, with the chief characters as follows: Face light yellow, a brown spot on tubercle extending more broadly to the oral margin, pile abundant, whitish. Cheeks greenish black, Eyes of male contiguous for a distance about half as long as the median length of the frontal triangle. Thorax shining greenish black; scutellum yellow, very translucent bluish opalescent. Abdomen black, subopaque, with 3 pairs of arcuated whitish yellow spots, those of each segment distinctly separated and from one another narrowly so from lateral margins.

Occasionally there are sporadic occurrences of a melanic form of the female in which the three pairs of whitish spots on the abdomen are absent (var. **unicolor**) (Fig. 4a). In some seasons these are fairly frequent, but in other seasons they are quite scarce or absent.

The eggs are chalk white, 1.02 x .44 mm. slightly broader at the non-micropylar end. Elevations barely 1/2 as wide as the interstices, about 6 times as long as broad, irregular in outline and connected by a network of ridges.

The incubation period varies from 3 to 10 days, according to the season. The newly-hatched larvae are pale yellow, with rows of long black hairs, body narrow, narrowing anteriorly from cauda. After feeding and a few days' growth, the larvae become greenish, some with a pinkish tinge, and have white lateral stripes. The larvae are very active, especially when the weather is warm, and reach maturity in from 12 to 25 days. The full-grown larvae are from 14 to 16 mm. in length and 3.5 to 4 mm. in width. The general color is pea green

to brownish green, paler toward the anterior end. There is a distinct white median stripe, and two fainter and more irregular white dorsolateral stripes. The body is wrinkled, and the segments distinct. The segmental spines are short and inconspicuous. The integment is beset with fine microscopic hairs. Caudal end square. Posterior spiracular tubes dark brown, contiguous, very short.

Catabomba larvae (Fig. 1c) attain a large size, and are capable of eating a large number of aphids, although, as with the other species, the number required for the larvae to reach maturity varies considerably. For single larvae the following food records were obtained: 302 **Illinola pisi** (stage ii), 403 (stages i-iv); 326 **M. rosae** (stages i-iv), 361 (stages i-iv), 412 (stages i-iv). Another record indicated that 2 larvae matured on 331 **Myzus persicae,** but produced undersized adults.

Pupation usually takes place on the soil under debris, but sometimes about half an inch in the soil. When first formed, the pupa is greenish-brown, with the whitish mid-dorsal stripe showing plainly. After a few days the pupa becomes a light chocolate to a sordid brown. It is broadly rounded at the anterior end, broadest in front of middle, tapering slightly to posterior end. Dorsum broadly convex, venter fairly straight, slightly concave toward posterior end. Segmentation indistinct. Integument papillose and armed with sparse pale hairs. Posterior spiracular tubes dark brown, shorter than their combined width, basally contiguous, apically slightly divergent. Length, 7 to 9 mm.; width 3 to 4 mm.; height, 3 to 3.5 mm.

The duration of the pupal stage varied from 12 to 22 days.

The adult is a strong, vigorous flier, and when confined in a cage, flies usually injured themselves in a few days by flying against the sides. None lived longer than 8 days.

All attempts to breed this species in confinement failed. Oviposition records of females captured in the field and placed in cages infested with aphids varied from 17 to 85 eggs during a period of from 1 to 5 days. Some or all of these females may have been partly spent when captured, and also might have laid more in confinement if they had not injured themselves in the cages.

Oviposition was irregular, one female depositing 29 eggs in a single day and dying 4 days thereafter. Another produced its entire quota of 47, while in captivity, in 2 days, and died two days later.

The above figures for the different stages of this species show that the period from egg to adult may vary from 27 to 57 days. As with the other species, development depends both on weather conditions and food supply. There doubtless are half a dozen generations in the year.

Catabomba larvae have been taken feeding on the following aphids: **Aphis gossypii, A. maidis, Brevicoryne brassicae, B. pseudobrassicae, Illinoia pisi, Macrosiphum albifrons** Essig, **M. rosae, Myzus persicae,** and **Chromaphis juglandicola.**

SYRPHUS NITENS Zett.

Both the Syrphus species occurring commonly in Southern California are to be found in about the same abundance and at the same seasons. As is the case with **Catabomba**, they are found during the cooler months of the year, most commonly in the spring and fall, and quite scarcely during the summer.

They are both large species, being a little smaller than **Catabomba** but a little larger than **Eupeodes.** (Fig. 5b.)

Syrphus nitens adults are 10 to 11 mm. in length. The eyes are bare, face yellow, with narrow black stripe from tubercle to mouth cavity; cheeks blackish, thorax shining olivaceous; scutellum dull yellow; abdomen black, with three yellow cross bands, which do not reach the lateral margins of the segment; first band interrupted entirely in center, the other two notched on lower margin in the center. Legs yellowish, coxae and base of femora black.

The egg is chalk white, elliptic, about equally broad at either end; elevations about 4 to 8 times as long as broad; their width 1/3 to 1/2 as great as that of the interstices, irregular in outline and connected with a network of ridges. Length 1 mm.; width .37 mm. The period of incubation varies from 2 to 7 days.

The newly-hatched larva is 1.25 mm. long, .25 mm. wide, pale yellow, elongate, and armed with black hair. On the whole the younger larvae of this species resemble those of **Eupeodes,** but are more elongate and lack the greenish color of **Eupeodes** larvae of the same age. They are a sordid light gray with brown markings on the posterior portion. After the first molt the general color is brown. The posterior half is ridged with transverse yellow bands, the anterior segments are greenish-white. The body is laterally ridged and bears short pale spines surmounting conical protuberances of the derm. Spines and elevations similar to Eupeodes, but not as prominent as in the larva of **Baccha clavata.**

The larvae are quite active, at least when conditions are favorable, and reach maturity in from 13 to 25 days. The full-grown larvae are 12 to 15 mm. long and 3 mm. wide. Observed closely, the color is greenish white, but the numerous light brown fat bodies beneath the derm give a light brown color to the larva as a whole. The dorsal vessel is blackish. The derm bears many areas of close-set minute blackish papillae. Posterior spiracular tubes fuscous, slightly divergent apically, each tube about as long as its basal width. Venter greenish white; segmental hairs pale, rather short.

Individual larval feeding records were as follows: 302 **Aphis gossypii** (Stages i-iv); 362 '**Macrosiphum rosae** (stages i-iv); 366, 374 and 378 **Myzus persicae** (stages i-iv).

The larvae pupate under debris on the ground. The puparium is light brown, with many small blackish spots and dots, and a narrow dark dorsal line. The dorsum is broadly convex, and the venter slightly concave. Anterior face has abundant short white pile; elsewhere each segment has a transverse row of 12 pale hairs; integument with areas of thickly-set black papillae as in larvae. Posterior spiracular tubes dark brown, short; basally contiguous; apically slightly divergent.

The duration of the pupal stage varies from 11 to 48 days. Adults bred in captivity lived from 4 to 9 days, while females captured in the field lived as long as 17 days.

Reared specimens would not mate in captivity. Several females taken in the field laid from 27 to 101 eggs, in oviposition periods extending from 2 to 11 days. Another female, taken in September, deposited 175 eggs in 8 days, dying 3 days thereafter. Deposition was irregular, 92 being laid in 2 days, 30 on another, and the rest scattered.

The total of the various stages, leaving out of consideration a preoviposition period, indicates that the egg-to-adult period varies from 26 to 80 days. There are probably about 6 generations in the year.

Syrphus nitens larvae were taken feeding on the following aphids: **Aphis avenae, A. gossypi, A. rumicis, Brevicoryne brassicae, Illinoia pisi, Macrosiphum cucurbitae, M. rosae, M. perlagonii** Kalt. **Myzus braggii, M. persicae, M. rosarum,** and **Thomasia salicola** Essig.

SYRPHUS OPINATOR O. S.

This species (Figs. 4d, 5a) closely resembles the preceding, both in size and appearance. The two may be distinguished by the fact that **opinator** has yellow cheeks, femora of female with the proximal half or more black, and the first pair of yellow abdominal spots reaching the lateral margin, while **nitens** has blackish cheeks and only the bases of the femora black, and none of the yellow markings normally reach the lateral margin of the abdomen. **Opinator** is perhaps slightly the larger of the two and the abdominal bands are a bright yellow.

The ovum is white, oval, with vertical elevations, appearing as if its surface were studded all over with short stoutish spicules. Broadest about 5/8 from micropylar end. Length 1.3 mm.; width, .6 mm. The egg sculpture is characteristic and dissimilar to that of the 3 previous species.

The incubation period varies from 4 to 7 days. The newly-hatched larvae are light yellow, cylindrical, with somewhat long and recurvent pale spines. Posterior respiratory tubes prominent, remote.

Full growth is reached ordinarily in from 12 to 32 days. Several records, however, during mid-winter, were considerably longer. One of 40, and another of 52 days were noted. Still another larva, hatching November 18th, reached full growth by January 1st, and then remained in that condition without movement for 3 weeks, pupating on January 22nd. This made a larval period of 65 days. The adult emerged on February 15th.

The full-grown larvae are light lemon yellow or yellowish-pink in color, paler along sides and toward anterior end. Dorsal vessel brownish or pinkish, lighter toward anterior end. Body obscurely ridged, pale spinose. Posterior spiracular tubes fairly prominent, 1 mm. in length, brown, fused, length equal to combined width at bases. Integument papillose, the closely-ranked paplilae hyaline. Length 12 to 14 mm.; width 6.5 mm.

This species is another voracious eater; but only one complete feeding record of it was obtained. An individual larva consumed 296 **Macrosiphum rosae,** stages i-iv.

The larvae seek some sheltered place for pupation, usually on the ground under leaves, etc., or in the ground. The puparia are light to salmon brown in color, at first with a paler greenish tinge toward anterior end. Hairs in transverse rows, pale, very short; integument closely papillose, papillae hyaline. Posterior spiracular tubes fairly conspicuous, fused, dark brown, reddish at tips, as long as combined basal width. Anterior face and dorsum broadly convex, dorsum sharply arcuate and concave before posterior spiracles, venter gently concave. The body narrows on the posterior half more noticeably than in **S. nitens** or **Eupeodes volucris.**

Later the color becomes a uniform light sordid brown, and a few days before emergence the reddish eyes and yellow striped dorsum of the imago show plainly through the puparium. Length 8 mm.; height 3.5 mm.; width 3 mm. (Fig. 3b.)

The pupal stage varies from 16 to 27 days. Bred specimens did not mate or oviposit in confinement, but several records of oviposition were secured; three females taken in the field on Brassica flowers (February) deposited 2, 12 and 24 eggs and died within two days. Adults lived as long as 14 days.

The figures given above for the various stages show that the period from egg to adult varies from 32 to 99 days. The number of generations per year is probably the same as for **S. nitens.**

S. opinator larvae were taken feeding on the following aphids: **Aphis gossypii, A. rumicis, Brevicoryne brassicae, Illinoia pisi, Macrosiphum rosae, M. albifrons** and **Myzus braggii.** In addition larvae in captivity fed readily on **Thomasia salicola, Myzus persicae** and **Macrosiphum acrosiphum pelargonii.**

SPHAEROPHORIA

There is some confusion in the present condition of the taxonomy of this genus, due chiefly to the fact that great variations in coloration and pattern exist, and that structural characters are rather weakly defined. A study of the male hypopygium indicates that among the species inhabiting Southern California **S. cylindrica** Say may be recognized as separable from the others by reason of the long hairs of the claspers. **S. sulphuripes** Thompson and **S. melanosa** Williston have short hairs on the claspers. Not unlikely there are more species in the material collected by the writers.

S. micrura O. S. is easily separable by reason of the small male hypopygium.

Life history records were made of two species, **S. cylindrica** Say and **S. melanosa** O. S.

All the species observed in Southern California are small and rather slender, and superficially resemble those of the genus **Allograpta.** They occur chiefly from late winter to mid-summer, and abound in April, May and June.

Considering the several species as a whole, the individuals are more numerous than **Paragus tibialis,** but not quite as abundant as either **Syrphus nitens** or **S. opinator.**

From 25 to 35 per cent of the individuals are the species **S cylindrica** Say. About 85 per cent of the remainder are referable to **S. sulphuripes** and **S. melanosa** together.

SPHAEROPHORIA CYLINDRICA Say.

The adults (Fig. 4c) are 7-8 mm. long, the males longer and with a narrower abdomen than the female. The main characters are as follows: Face pale yellow, with a brownish median blotch variable in extent. Eyes bare. Antennae light orange. Thorax with cinereous stripes and a yellow lateral stripe from the humeri to the roots of the wings; scutellum yellow with yellow pile. Legs yellow, the basal half of the femora sometimes testaceous. Abdomen black, with yellow cross-bands in the male, the posterior half often largely reddish-yellow, in the female the bands are more arcuate and narrower.

Egg. Length, .9 mm. diameter .3 mm. Elongate oval, chalk white, elevations of the chorion 2 or 3 times as long as wide and about twice as wide as the interstices.

The incubation period was 4 to 5 days in April.

The newly-hatched larvae are pale yellow, .95 mm. long and .25 mm. wide, cylindrical, devoid of vestiture.

Full-grown larva pea green, with white median longitudinal stripe (Fig. 2b). The color is a little darker green than **Allograpta,** and the body in general stouter. In shape and armature the species are very similar. Posterior respiratory tubes noticeably shorter than **Allograpta,** light brown, not divergent distally, fused, except at tips, about 1 1/2 times as long as combined basal width.

The larval period was 11 to 12 days in warm weather. Pupation took place on the leaves, or under debris on the ground.

The pupae are greenish, rather narrow, anterior face bulbous, dorsum convex, evenly descending from top of arch to respiratory tubes; venter gently concave; the sides taper evenly from third segmental region to the cauda; posterior respiratory tubes as in full-grown larvae. Vestiture short and inconspicuous.

The pupal stage was 8 to 9 days. Attempts to breed in captivity were not successful. One female taken in the field produced 12 eggs in 3 days. In captivity adults lived as long as 10 days.

Larvae of this species were taken feeding on **Aphis gossypii, A. rumicis, Chromaphis juglandicola, Brevicoryne brassicae, Myzus rosarum and Illinoia pisi.**

SPHAEROPHORIA MELANOSA Williston.

This species occurs frequently during the summer months, but is not so common as **cylindrica.** The adult female has a little larger abdomen than **cylindrica.** The abdomen has more black and the 3 cross bands are as follows: 2nd, 3rd and 4th segments each with a slender, gently arcuate, yellow cross band, the first and second of which are interrupted in the middle.

The male has more black on the abdomen, second segment with a narrowly interrupted arcuate yellow band, third segment with a broader entire one, fourth with two narrowly interrupted yellow spots in front, fifth with two smaller ones. Legs brown.

The ovum is chalk white, oval, .8 x .3 mm., the extremities more truncate than in other Syrphid eggs, raised portion of chorion in alternate longitudinal lines, of varied shape, asteroid, each about 3 times as long as wide, broader than the intervening hyaline spaces; connecting ridges, very fine; dorsum of ovum convex.

The larvae and pupae are very similar to those of **cylindrica.**

In April and May the period of incubation was 4 to 5 days, the larval stage 18 to 23 days and the pupal stage 10 to 12 days.

Individual larvae consumed 161, 175, 211, 240 **Myzus rosarum** (stages ii-iv).

Melanosa larvae have been taken feeding on **Aphis gossypii.**

BACCHA CLAVATA Fabr. (**Babista** Walker).

This Syrphid is entirely different in appearance from any of the others, having a long, slender abdomen, very narrow toward the base. Moreover, it is one of the summer forms, appearing first in June, becoming most abundant in July, August and September, and disappearing in November. Although the adults of this species are less common than **Melanostoma,** the larvae have been observed much more frequently.

The adult is 10 to 11 mm. long; the abdomen itself being 6 to 7 mm. The chief characters are as follows: Eyes large and red, face yellow, cheeks black. Thorax shining greenish blue. Scutellum yellow, brown or brownish across the disc. Abdomen long, slender at second segment, rather broadly spatulate at distal end, black or brownish black. A pair of divergent white spots occur on second and third segments.

The eggs are chalky white, .65 mm. by .16 mm., slightly more truncate at the non-micropylar end, somewhat depressed and compressed at the narrower extremity. The whitish elevations of the chorion are elongate oval in form, four or five times as long as broad.

The duration of the incubation period was from 2 to 3 days.

The young larvae are yellowish grey with prominent pale spines. The larvae are not as active as those of some of the larger species, but full growth is reached in a comparatively short time, the period extending from 8 to 11 days.

Larvae in the last instar vary somewhat in color, specimens feeding on **Aphis gossypii** being lighter than those feeding on **A. medicaginis.** The larvae are chiefly characterized by their unusually prominent spines and short posterior spiracular tubes. They slightly resemble the larvae of **Eupeodes,** which, however, have shorter spines. The general color is a greenish brown with a mid-dorsal stripe of light orange, and the tenth and eleventh segments flesh-colored.

The full-grown larvae are sordid whitish, cylindrical; cauda truncate; on the dorsum from 4th to caudal segment color varying from

green to pink and light brown; numerous whitish fat bodies show under integument; on dorsum and along sides of integument occur small areas of black granulations. Each segment is armed with hyaline spines in transverse rows, the sides markedly ridged and the derm produced into conical spiniferous protuberances. Posterior spiracular tubes brown, short, each as wide as long. The extended larvae are 9 mm. to 10 mm. long. They somewhat resemble those of **Paragus tibialis** in shape and spine arrangement, but may be separated by their short respiratory tubes and prominent dorsolateral stripe. **P. tibialis** larvae are also flatter and the body tapers abruptly before the posterior extremity.

But one food record was obtained, in which a larva consumed 181 **Aphis medicaginis** Koch (stages i-iv).

Pupation takes place on the plant on which the aphid host lived. The pupa at first is the same color as the full-grown larva and later turns yellowish-gray. Dorsum evenly convex, anterior face bulbous; venter concave. Sides evenly narrowing caudad of third segment. Armature of pale conspicuous spines not unlike those of **Paragus tibialis**; integument punctate and papillose, papilli fine and short; posterior spiracular tubes short, singly as broad as long, cylindrical, slightly divergent, not fused basally, brown. Length 4.5 to 5 mm.; width 2 to 2.2 mm.; height 1.9 to 2.1 mm.

The pupal period varied from 6 to 10 days. In confinement adults lived as long as ten days.

Attempts to breed reared specimens in confinement were not successful. One female captured in the field deposited 34 eggs in 5 days. Another laid 17 eggs in one day.

Although this species is active only about half of the year, it is probable, due to the short time it takes to mature (16 to 24 days) that there are 5 or 6 generations per year. The winter is passed in the pupal stage, the adult fly not appearing until the beginning of summer.

Larvae were taken feeding only on **Aphis gossypii, A. rumicis** and **A. medicaginis. Pachyneuron californiconi** was bred from this host.

PARAGUS TIBALIS Fallen.

This Syrphid is one of the summer-appearing forms, being fairly abundant around certain plants in June, July, August and September. A few specimens may be taken in October, and one was recorded in February. In abundance it ranks a little above **B. clavata.**

It is the smallest aphidophagous species, with a rather stout body. The length is from 3 to 5 mm. Eyes black, face yellowish-white; cheeks dark; thorax black or black green; scutellum black; first and second segment of abdomen black, third, fourth and part of fifth reddish; tip black. Some individuals have the abdomen entirely black.

The incubation period varies from two to three days. The newly-hatched larvae are cylindrical, light yellow, black pilose. The larvae are not as active as those of the more common species, but reach maturity in from 10 to 14 days. The full-grown larvae are light yellow, with the anterior third or less pink on the dorsum. Each segment is armed with a transverse row of pale spines. The posterior spiracular tubes are rather long, tipped with brown.

Pupation takes place on the infested leaves, on the ground under leaves or debris, or at the base of the stem of the infested plant. The pupae are light sordid to medium or dirty brown, darker at cephalic end, a transverse row of six short, white spines on each segment;

integument finely punctate; posterior spiracular tubes cylindrical, prominent, dark brown, blackish at their apices, a little longer than combined base width. Dorsum convex, the curve sloping gently from the highest point to the base of posterior spiracles, anterior face convex, venter gently concave. The general shape is similar to **Allograpta,** but the latter is smooth.

The duration of the pupal stage varied from 10 to 14 days.

Adults lived in captivity as long as 18 days. Attempts at breeding in confinement were all failures. Females captured in the field deposited 25 and 48 eggs in 11 and 6 days respectively.

Larvae have been taken feeding on **Aphis gossypii, Aphis maidis** and **Aphis rumicis.** A few were parasitized by **Pachyneuron.**

Although this species is only present for about 5 months in the year, its rapid development, varying form 23 to 30 days from egg to adult, indicates that there are about 5 generations in the year.

PARAGUS BICOLOR, Fab.

This is a very similar species, closely resembling **tibialis,** but a little larger, and the scutellum has a yellow border. Larvae of this species were taken but once in Southern California feeding on **Aphis rumicis.** It was also taken once not far from the south-eastern border of the San Francisco Bay. It appears to be rare in the Sonoran region, but may be commoner in the Sierran.

EXPLANATIONS OF FIGURES

1a. Eggs of Eupeodes volucris O. S. on young cabbage seedling. Colony of Brevicoryne brassicae.
1b. Eggs of Allograpta obliqua Say on corn seedling.
1c. Eggs and larvae of Catabomba pyrastri L.
2a. Half-grown larva of Eupeodes volucris O. S. on grass blade.
2b. Full-grown larvae of Sphaerophoria on bean leaf.
2c. Half-grown larva of Allograpta fracta O. S. on grass blade. Colony of Aphis maidis.
3a. Puparia of Allograpta obliqua Say on pods of Sterculia sp.
3b. Puparium (side view) of Syrphus opinator O. S.
3c. Puparia of Melanostoma stegnum Say.
4a. Adult flies of Catabomba pyrastri L.; male, melanoid female (var. unicolor), normal female.
4b. Adult flies of Eupeodes volucris O. S., female and male.
4c. Adults of four species of aphidophagous flies; Sphaerophoria female; Eupeodes volucris, female; Syrphus nitens Zett., female; Catabomba pyrastri, male.
4d. Adults and puparium of Syrphus opinator O. S.; male and female flies.
5a. Adult female of Syrphus opinator O. S.
5b. Adult female of Syrphus nitens Zett.

Figures 1a, 1c, 2c, 4b, 4c, 4d enlarged. Figs. 2a, 2b, 3b, 3c, 5a 5b greatly enlarged.

Plate E. Larvae of Bichavata, E. volveris and P. tibialis.

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Southern California Academy of Sciences

LOS ANGELES, CALIFORNIA

Vol. XXIII May-June, 1924 Part 3

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Issued June 15th, 1924.

Southern California Academy of Sciences

OFFICE OF THE ACADEMY

Southwest Museum   Los Angeles, Cal.

THE HYTHERGRAPH

AN INSTRUMENT FOR RECORDING HUMIDITY AND TEMPERATURE

BY FORD A. CARPENTER, D. Sc., LL. D., F. R. G. S.

Illustrated by the Author

Need of a portable humidity-temperature recorder—For many years there has been need of a portable instrument which would automatically record temperature and humidity under the strain or jar of rough handling in transportation of all kinds. Aeronauts, aviators, meteorologists; refrigeration, ventilation and heating engineers; florists, horticulturalists and traffic managers of land and water shipments of fruits and vegetables—all these have greatly desired a dependable instrument which would accurately register these two prime variables of air temperature and air moisture. In order to supply the evident need of such an instrument, the *hythergraph has been designed. The temperature element in the hythergraph is the well-known bi-metallic strip; the humidity element is the equally well-known strand of human hair freed from the natural oils. The former is tested by means of the mercurial thermometer and the latter by the sling psychrometer. The indications of the hythergraph test within 2% of the standardized instruments.

Type of temperature-humidity devices in general use—Self-recording thermometers and hygrometers have been in use for a score or more of years. During the past decade, meteorological instrument makers have designed a hygrothermograph which, as the name indicates, registers both temperature and relative humidity. Such instruments are accurate and dependable in their performance as weather indicators, but owing to their weight and size they are not portable. It may also be mentioned that their extreme susceptibility to shock limits their use to exposures in a stationary position. The hygrothermograph measures about 5 inches wide, 7 inches high and 18 inches long and weighs approximately about 20 pounds.

For strictly aeronautical work many designs of meteorographs have been invented. A meteorograph records pressure as well as temperature and relative humidity. Such instruments are used in upper air investigations.[1] These meteorographs are of light construction and when used where there is no vibration they give legible

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*The name "hy-ther-graph" was coined for the instrument because it concisely conveyed the meaning of a humidity-temperature-recorder. The designation of the record-sheet "hythergram" naturally followed.

The Author is indebted to Dr. C. F. Talman, an American authority on meteorological terms, for calling his attention to a previous use of the word "hythergraph" in "The Australian Environment", Melbourne, 1918, p. 30, where in quite a different sense, Dr. Griffith Taylor, a colleague of the author's, and an authority on meteorology, "applies the name (states Dr. Talman) to a graph in the form of a 12-sided polygon showing the normal monthly values of rainfall and mean temperature for a station or a region, for the purpose of camparing climates with reference to their agricultural possibilities."

Is it not a strange coincidence that two people on different sides of the globe should simultaneously originate a word and use it (in both instances properly) for entirely different purposes and to convey a different meaning?

[1]"California Climatic Conditions" **Univ. Cal. Chron.** Vol. 17, No. 1.

records. Probably the best American models for such purposes are those designed and used by the Weather Bureau. They are light in weight and compact in form and when they are suspended in an upright position and placed where they are not subject to rough handling or vibration, their records are satisfactory. England has the lightest upper-air meteorograph, and Germany, before the World War, manufactured the sturdiest instrument of this character.

Description of the hythergraph—The hythergraph is a new departure in a meteorological recording apparatus. It is one-third the size of any other registering instrument of similar purpose and weighs from one-half to one-fourth as much. This compact design permits registration of two or more sets of conditions over a considerable period. These conditions can be readily interpreted at a glance and inspected any time during the process of registration. This is ac-

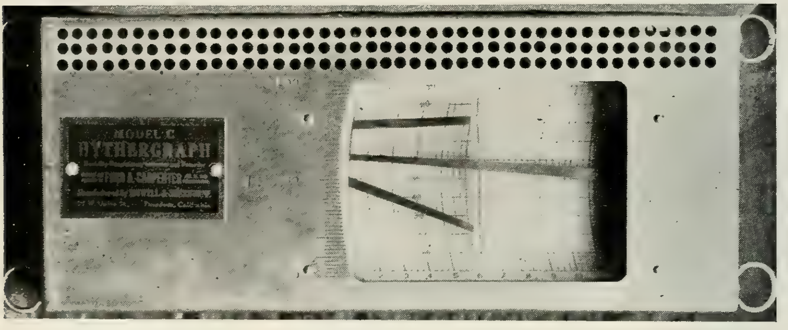

PLATE NO. 1.

OUTSIDE VIEW OF HYTHERGRAPH (Half Actual Size)

Thermographs and hygrographs have been available for more than a score of years. It has been heretofore, impracticable to use them in a number of situations because of their bulk and absence of portability. Owing to their construction the recording pens are in constant contact with the sheet making a continuous record, thus the instruments cannot be moved without making the record illegible.

In the hythergraph the pen is on the sheet less than a minute's time; this makes it possible to use it in airplanes, balloons and on all kinds of aircraft generally. Besides being small (4x8x1¾ inches) and light (weight 3 pounds) it is flat and indicates the temperature on one side and the humidity on the other. A dual record is made possible by the use of a continuous band of recording paper feeding over two rollers placed at such a distance from each other that the records can be readily seen.

complished by means of transparent windows on either side of the case (see plates 1 and 3).

The instrument is both indicating and recording: the former is accomplished by means of graduated scales on the cover. Radium figures are also provided so that the temperature and humidity readings may be available in the dark as well as in the light. Such an arrangement is not only a great convenience to industrial users of the hythergraph, as, for example, by fumigators whose work requires them to do much of their work at night, but to airmen during their voyages.

A gear-shift has been introduced in model C, so that the hythergraph may be instantly changed from a daily to a weekly record. The driving mechanism is a standard American jewelled clock movement with lever escapement. The design is both rugged and compact, made to operate under all conditions.

Operation of the hythergraph—Some of the important features of the operation of the instrument are: First, a continuous roll of paper having ordinates representing time, and abscissa representing chiefly the values of the two variables—temperature and relative humidity (see plate 2). Second, the action of the pens. The pens which hold a supply of ink for the period of operation (24 to 168 hours) are actuated by a thermometer and hygrometer of standard design. The pen arms are at opposite sides of the paper—carrying rollers and they touch upon points on the paper which would be diametrically opposite if the paper were removed and expanded to cylindrical form (see pl. 3). Third, the paper is moved by clockwork at such speeds that there is a complete rotation in 6, 24 or 168 hours representing a quarter of a day, a day or a week, as may be desired for a particular kind of record. In the 24-hour model the pens record simultaneously on lines which are 12 hours apart, that is, one pen is at 2 a .m. when the other is at 2 p. m. Fourth, to avoid confusion, the lines made by the temperature and humidity pens are of different thickness. This arrangement makes two colors of ink unnecessary. Fifth, in order to render the instrument portable without disfiguring the record by accidental jostling, vibration incident to transportation by airplane, airship, automobile, railroad car, or other means, the pen arms are pivoted and actuated by cams driven by the clock mechanism. The

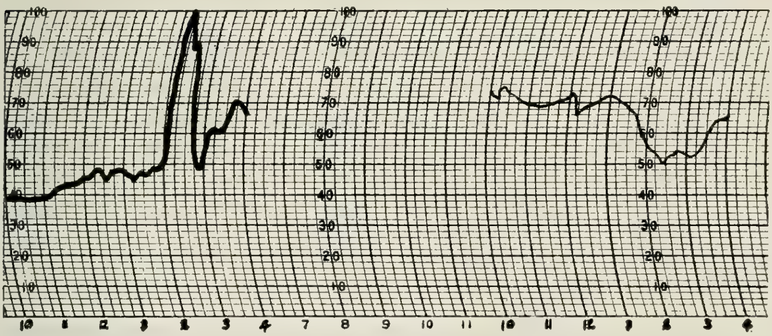

FIG. NO. 1.

HYTHERGRAM OF A NAVAL SEAPLANE FLIGHT, MAY 5, 1920.

The location of the hythergraph.

The hythergraph was slung over the mooring-bitts well forward on the seaplane. It was unstayed and therefore subjected to the high wind velocity and the spray when taking off and touching the water on alighting.

The temperature and relative humidity record.

Automatic registration of Temperature and Relative Humidity in a flight in Naval Seaplane No. 4 (F4L) between Los Angeles Harbor and San Diego Bay. Elapsed time 77 minutes.

The vertical interval is one-quarter hour; the horizontal interval is 2° Fahr. and 2% relative humidity.

The record shows the following:

Time	Temp.	Rel. Hum.	Summary
2:10 p.m.	54°	98%	Mean temperature 53°.
2:20	50	94	Highest temp. 55° at 3:12 p.m.
2:30	52	84	Lowest temp. 50° at 2:20 p.m.
2:40	53	60	Highest rel. hum. 98% 2:10 p.m.
2:50	54	50	Lowest rel. hum. 50% 2:50 p.m.
3:00	53	53	
3:10	52	61	
3:20	54	62	

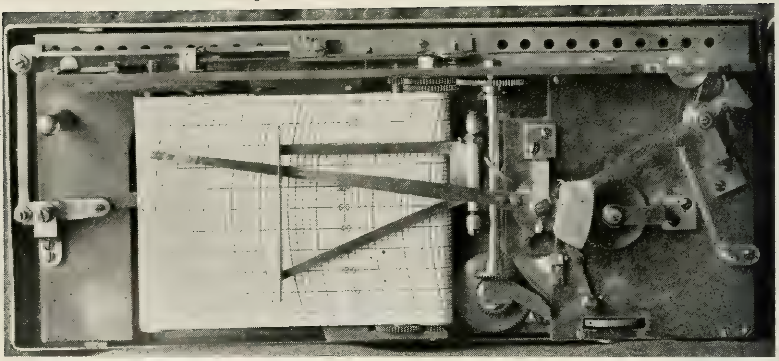

PLATE NO. 2.

INTERIOR OF HYTHERGRAPH

The hythergraph is accessible from both the temperature and humidity sides: the illustration shows the main working parts disclosed from the humidity-recording side.

1. Temperature element in the form of a bi-metallic strip.
2. Relative humidity element as strand of human hair.
3. Record tension spring.
4. Hygrograph recording pen dotting every minute for a second's duration.
5. Pen-lifting device, operating both temperature and humidity pens.
6. Lever to lift both pens when changing record sheets, etc.

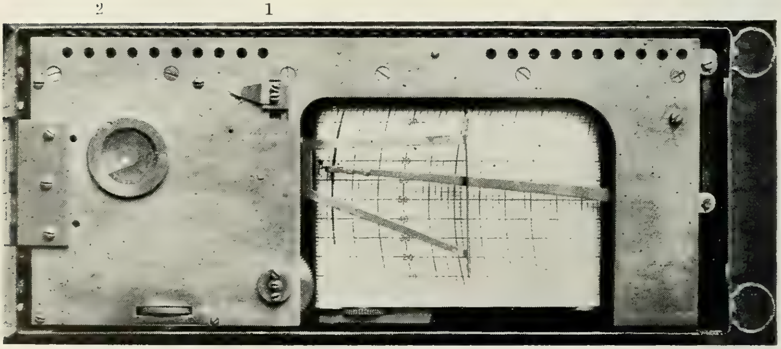

PLATE NO. 3.

OPPOSITE (Temperature) SIDE OF HYTHERGRAPH

1. Gear shifting device: the indicator in its present position shows that the hythergraph will make a daily hour record. By sliding the lever down one notch the hythergraph will make a weekly record.
2. Clock escapement: the movement is inclosed in a strong case.
3. Winding stem.

operation is somewhat similar to that employed in the well-known Richards barograph. The object of the cams is to lift the pens at one-minute intervals and so produce a dotted line which is thus practically vibration-proof, and, owing to the proximity of the dots, is, to all intents and purposes continuous. There is also the added advantage of the lines being less liable to smear than in the case where a continuous record is made. Sixth, the hythergraph has special utility in that the character of both the recording mechanism and motor are such that the instrument operates in any position with equal facility; this is essential in a pocket instrument. Seventh, the instrument is indicating as well as recording. Furthermore, the instrument is of convenient and small size, measuring 8 inches in length, 4 inches in width and 1¾ inches in thickness and weighs about 3 pounds.

Additional modifications of the instrument—In the additional modifications each possesses the same fundamental features except that the clock movement is geared for a fast revolution of the paper-roll, as in the case of the aircraft model where the abcissa have a value of 4 minutes, or in the case of the industrial or meteorological design where the value is 4 hours.

Special aeronautic model—It is also proposed to incorporate in a special aeronautic model a simple aneroid barometer cell so that an attached pen will mark the altitude. The ruled horizontal lines on the sheet will then represent value of 500 feet, the instrument having a range of 25,000 feet. Work is now being done on yet another model which will have a wind measuring device. This is accomplished by carrying an ordinary pressure-plate lever within the case and there operating another pen-arm which traces directly on the sheet the varying wind pressure in pounds per square foot and miles per hour.

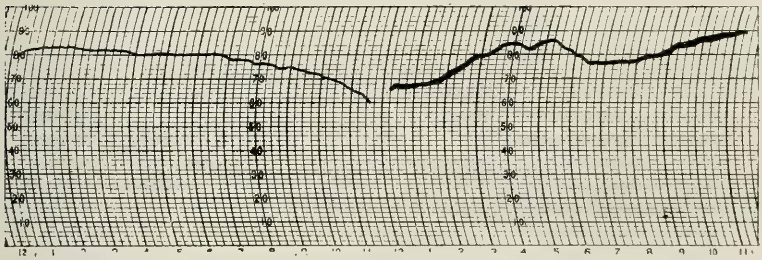

FIG. NO. 2.

HYTHERGRAM, CAMPUS, SOUTHERN BRANCH, UNIVERSITY OF CALIFORNIA

The tracing to the left is Temperature, to the right Relative Humidity; the former is a thin line, the latter a heavy line. The reproduction of the hythergram is nearly actual size.

Lighter-than-air Craft—In lighter-than-air craft, which includes balloons and airships, it is necessary for the pilot to know at all times during the flight, the humidity as well as the temperature of the air. The hythergraph proves a ready means whereby the pilots may observe the tendency of the air to become warmer or colder, drier or wetter. As aeronauts deal with expansion and contraction

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INSTRUMENTAL TRACINGS(Automatic) DURING BALLOON FLIGHT
10:07 a.m. to 12:27 p.m., June 8, 1920

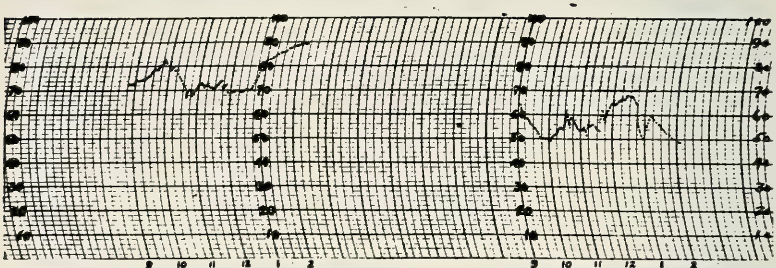


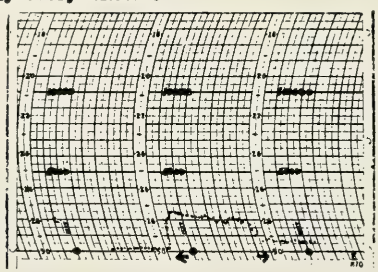
Fig 3a

Thermometric tracings degrees Fahr.

Hygrometric tracings percentage saturation

The time element is in hours and quarters, as indicated; the horizontal values are in 2 degree and 2% values, temperature (Fahr) and relative humidity (percentage in saturation) respectively. The dots are made instrumentally every minute.

Fig 3b



BAROGRAPH (Richards)

The time element is in ten-minute intervals, the flight is embraced in the brackets. The horizontal values are in 500 ft. intervals, the whole scale being 15,000 feet; all data is above mean sea-level.
The dots are made every minute by clock action.

FIG. NO. 3.
HYTHERGRAM OF BALLOON FLIGHT FROM CAMPUS

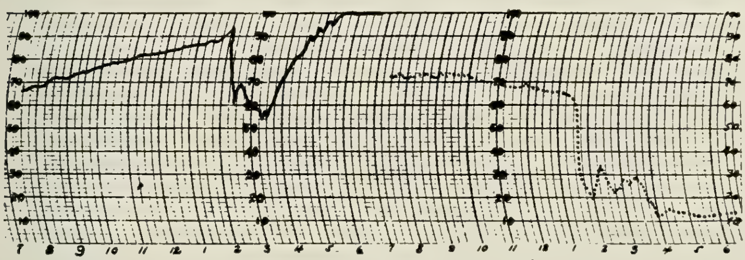
As part of the instruction of the meteorological class of the Southern Branch, University of California, a U. S. Army Service military balloon flight was made from the campus. The hythergraph formed part of the equipment.

The upper record sheet is from the balloon flight and shows the automatic readings from the hythergraph.

The lower record sheet is from a Richard's barograph and shows the varying altitude and time.

Model C, Hythergraph, is designed to show altitudes similar to that shown on this page by the insertion of an aneroid barometer element within the case; the instrument showing an extreme altitude of 25,000 feet by 500 feet intervals.

changes in volume of the lifting gas-envelope, they should have within easy observation a reliable and readily observed temperature and humidity instrument. The multitude of instruments which now find a place on the instrument-board of an airship, or are suspended from the concentration-ring of a balloon, should not be unnecessarily increased, for they would confuse the navigator. For this reason a small, compact, sensitive recording apparatus such as the hythergraph for use during the voyage, and as a record at its completion is considered essential by many air-pilots. It must not be supposed that such an instrument means an additional care; it entails no responsibility to the pilot or observer after the clock is wound and the recording pens are set (see pl. 7, fig. 5). The hythergraph has been used on airship and balloon voyages with marked success. Aeronauts find that a steady increase in humidity presages fog or cloud formation. Should the temperature trace show a slow but steady increase, ballasting may be dispensed with in case ascension is desired.[3] On the contrary, a persistent fall in temperature, as is best shown by a recording thermometer, would prevent undue valving to accelerate descent. The instrumental tracings of the hythergraph make an invaluable addition to the log of a balloon or dirigible flight.



HYTHERGRAM OF JULY 26.1920.

The solid line represents the temperature variation by degrees from 0 to 100; the time element is by 15 minutes, the hours are marked on the lower margin of the sheet. The dotted line shows the relative humidity in percentages in saturation, the scale running from 0 to 100%.

Temperature: It will be observed that there was a steady increase in temperature from 7:30 a.m.(time of leaving Los Angeles on trolley to just before leaving the ground at March Field at 2:00 p.m. The subsequent variations in temperature synchronized with the elevation of the plane, the lowest temperature, 54°, occurred at 10,000 feet, at 3:15 p.m.; the highest temperature, 100°, on landing at Fresno.

FIG. NO. 4.

HYTHERGRAM OF AIRPLANE TRIP, LOS ANGELES TO SAN FRANCISCO, JULY 26, 1920

The above photograph illustrates the action of the hythergraph on an airplane journey from Los Angeles to San Francisco. This instrument was suspended beneath strut No. 10 on the port wing of DH-4 No. 63775. It is interesting to note that the lowest temperature (54°) was registered at the maximum altitude (10,000 ft.) and the highest temperature (100°) on the ground. The least humidity (12%) likewise occurred near the ground, and the highest, (75%) in entering the elevated mountain passes. The variation in temperature registered between 3 and 3:30 p.m., and between 4:45 and 5:20 p.m. was caused by the differing character of terrain encountered with characteristic changes in reflection and absorption.

[3] "Solo Flight in a Spherical Balloon," Bull. So. Cal. Acad. Sci. Apr. 1921.

Exposure of hythergraph on a free-balloon flight—In operation, the instrument is suspended from the concentration-ring of a balloon. This is a wooden ring to which is attached the net encompassing the gasbag. Below the concentration ring is suspended the basket. Fig. 3 shows such a record which was made during a voyage from the campus of the Southern Branch of the University of California on June 8, 1920. This free-air flight was part of the instruction tendered the classes in meteorology by the writer. This interesting and instructive demonstration of the effectiveness of meteorological knowledge in guiding a balloon to a previously designated location was made possible through the courtesy of the Chief of Air Service, War Depart-

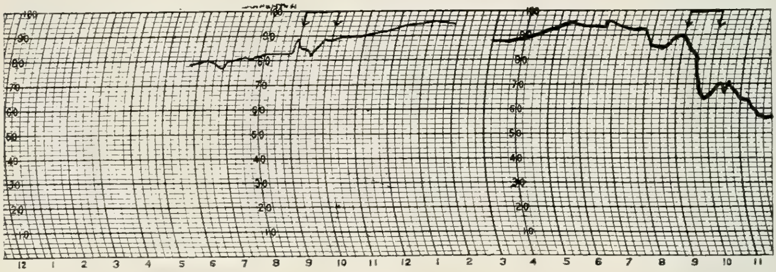


FIG. NO. 5.

HYTHERGRAM OF A U. S. ARMY DIRIGIBLE FLIGHT

On July 8, 1921, the U. S. Army Airship C-2 made a voyage from Langley Field to Portsmouth, Va. and return in order to test the hythergraph. The above reproduction shows the record sheet made on that trip.

The record shows the following data:

Time	Temperature	Relative Hum.	Time	Temperature	Relative Hum.
9:00 a.m.	88°	88%	9:40 a.m.	88°	78%
9:10 a.m.	82°	82%	9:50 a.m.	91°	63%
9:20 a.m.	80°	84%	10:00 a.m.	89°	64%
9:30 a.m.	82°	88%			

Maximum temperature, 91° at 10:02 a. m., Minimum temperature, 80° at 9:20 a. m.; Maximum relative humidity 88% at 9:00 a. m.; Minimum relative humidity, 61% at 10:02 a. m.

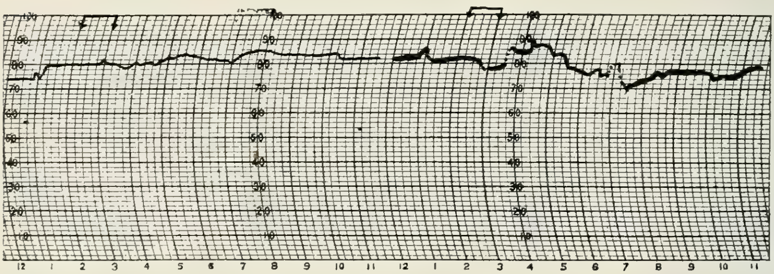


FIG. NO. 6.

HYTHERGRAM OF A STROLL OVER OFFICIAL WASHINGTON

On July 12 the author put the hythergraph in his pocket and walked about the city of Washington. The portions of the record inclosed in arrows show the temperature and relative humidity of the United States Senate Chamber during President Harding's speech (2 p.m. to 3 p.m.). It is believed to be the first time that a record was made of the air temperature and air moisture in this building during a presidential address.

The record shows that the temperature during President Harding's speech ranged from 80° to 82°, and the relative humidity from 78% to 83%.

ment. During the flight the temperature ranged from 66° to 90°, or passed through a range of 24° Fahr. The relative humidity covered an amplitude of 20%, ranging from 48% to 68%. The hythergram of the journey is shown by Fig. 3A. The changes in altitude during the journey are shown by Fig. 3B: the maximum altitude during the ascent was 2,500 feet above sea level and the average altitude of the flight was 2,000 feet.

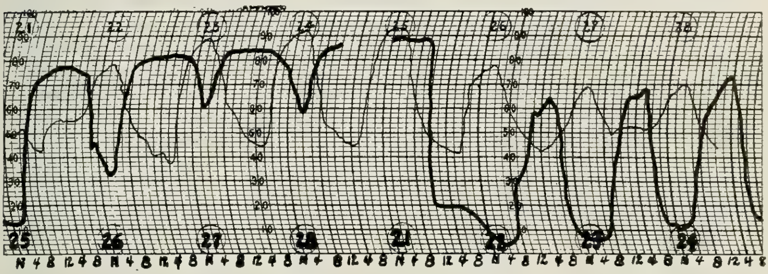


FIG. NO. 7.

WEEKLY HYTHERGRAM, RIVERSIDE, CALIFORNIA

As a meteorological instrument, the hythergraph is useful in that it accurately records temperature and relative humidity in a compact and easily accessible manner. The temperature record is indicated by a light line and the dates of the temperature are entered above. The relative humidity trace is shown by means of a heavy line and corresponds to the dates at the bottom of the sheet.

PLATE NO. 4.

CAMPUS OF SOUTHERN BRANCH, UNIVERSITY OF CALIFORNIA

The hythergraph was exposed on the campus of the Southern Branch, University of California, in the vicinity of Millspaugh Hall, corridor of Room 213, (where the Meteorological lectures are given), with the record in Fig. 2.

Hythergrams of airship voyages—The hythergraph can not well be dispensed with when it has once been used in either airship or balloon flights. Airships (dirigible-balloons) travel in no such leisurely manner as a balloon; the pilot must have a thermometer and a hygrometer within reach. The manner in which a hythergraph was

PLATE NO. 5.
BALLOON VIEW, CAMPUS OF SOUTHERN BRANCH, UNIVERSITY OF CALIFORNIA

The temperature slowly dropped, as shown by the hythergraph and the humidity rose. An automatic record was made by the hythergraph throughout the flight of three hours.

PLATE NO. 6.
HYTHERGRAPH ON AN AIRSHIP OFF THE VIRGINIA CAPES

On a test flight with the U. S. Army Airship C-2, the hythergraph was suspended by a cord beneath the strut which supported the wind-recorder as shown in the photograph.

This position insured good exposure for the hythergraph and it also permitted the pilot to readily observe the changing atmospheric temperature and relative humidity.

exposed on a recent (1921) airship flight over the Atlantic ocean and along the eastern coast of the United States is shown on plate 6, and a record of such flight in an Army dirigible is shown by Fig. 5. It will be noticed also from plate 6 that the hythergraph was exposed in the air-stream well forward just beneath the speed indicator.

HEAVIER-THAN-AIR INSTRUMENTAL BEHAVIOR

In heavier-than-air craft, such as airplanes and seaplanes, the hythergraph is useful in giving the same definite warning—through the medium of the humidity trace—of the approach of thick weather. The temperature trace shows changes of temperature incident to elevation (see Fig. 4) and, also directly, the character of the ground as to whether it reflects or absorbs the sunlight during the flight.

Fig. 4 shows that unlike the changes in temperature and humidity which occur on the surface of the earth, **the humidity decreases with the temperature.** This is owing to the fact that the relative humidity as well as the temperature is normally lower in increased altitude. On the surface of the earth, especially is this marked in California (see Fig. 7) the humidity decreases as the temperature increases.

Tests conducted during the past four years, have demonstrated the practical value of the hythergraph in general aeronautics. In such work it is important to differentiate between experimental and routine records. Both are essential to aircraft operation for the newness of the science makes it imperative that complete automatic records be available whenever possible.

PLATE NO. 7.

U. S. ARMY AIRSHIP C-2, CARRYING HYTHERGRAPH

This historic airship has the interesting record of having flown from New York to Newfoundland and return, and also from the Atlantic to the Pacific Coast.

This photograph was made while the ship was on a cruise over Hampton Roads, Virginia: during this flight the hythergraph was suspended on the starboard bow (see pl. 6).

One of the model A hythergraphs is owned by the U. S. Air Service and has been used at western and eastern air fields. It is now part of the instrumental equipment at Scott Field, Illinois, which is the central lighter-than-air station of the U. S. Air Service.

HYTHERGRAPHS IN WEATHER STUDY

It has been found that in the application of meteorology to agriculture it is necessary to use selfrecording thermometers and hygrometers. In practice the utilizing of automatic records is needful in studying the idiosyncracies of local climates. Eye observations of temperature and humidity are useful but chiefly so to check up recording instruments. With automatic data at hand it is feasible to make profitable comparisons of climatic areas and thus intensively apply the information directly to the problem.

HYTHERGRAM OF THE CAMPUS, SOUTHERN BRANCH, UNIVERSITY OF CALIFORNIA

As an experiment, the hythergraph was exposed in one of the courts on the campus of the Southern Branch of the University of California. The general location of the instrument is shown by plate 4, and the resulting instrumental traces are shown by Fig. 2. This is an example of the ease with which a "cross-section of local climate" may be secured. It is often desirable to secure a 24-hour record of temperature and humidity, and by comparing such records with those from established stations, it is practicable to make a fairly good meteorological reconnoissance.

Weekly hythergram, Riverside, California—The weekly record of temperature and humidity is far more valuable than the daily record in the study of weather affecting agriculture. Such a record is shown by Flg. 7, and the hourly variations, shown for the last week in February, are those occurring at Riverside, Cal. During this period the temperature varied from 37° to 93°, and the relative humidity from 3% to 88%. It may be said in passing, however, that such records are not unusual. For example, during the last week in October, 1921, in Riverside county, the temperature variation as shown by the hythergraph ran the gamut of seventy-one degrees in 24 hours, or from 29° to 100°. During such considerable temperature changes and corresponding humidity changes (in such instances amounting to nearly 100%) it is essential to have automatic registration of the time as well as the range otherwise the affect of air conditions on plant growth could not be properly studied.

INDUSTRIAL APPLICATION OF THE HYTHERGRAPH

Perhaps the most practical field for the hythergraph is among the various industries affected by changes in air temperatures and air moisture. In the textile mills, for example, where the proper percentage of humidity of the air determines the success or failure in spinning, the hythergraph should be extensively used. Temperature and humidity play a most important part in the majority of industries and a study of these elements is economically essential.

To keep the air dry as well as cool in summer, and to maintain warm air in winter that is not so robbed of its moisture as to be comparable to that over a desert is the dispair of heating and ventilating engineers. Selfrecording apparatus that cannot be interfered with is essential to such studies. The need of a modern and efficient cooling

system for the United States Senate Chamber could not be more graphically represented than by the hythergram (Fig. 6) which was made during the Presidential address of July 12, 1921.

The hythergraph is an aid to florists and warehousemen—Florists and others dealing with those twin necessities—heat and moisture, require accurate data on which to note the growth of plants. Fruit and vegetable packing-houses are generally without the means of determining whether their rooms are dry or moist: the thermometer alone is no indication of atmospheric moisture. There has long been desired an instrument which could not only be locked up within the greenhouse or warehouse and which would render a truthful report, but which would also indicate to the supervisor the exact degree of temperature or humidity so that imperfect heating or hygroscopic control might be corrected.

Observations on refrigeration and cold-storage—Refrigeration and cold-storage engineers have long desired a satisfactory **portable** instrument which would give a dependable record of temperature and humidity. The shipment of perishables in refrigerator cars or ships is always attended by much risk if great care is not exercised in the control of temperature and humidity. The cause of damage to shipments in transit may be directly traced if the shipment is accompanied by a hythergraph.

The use of fruit steamers to handle the immense citrus fruit crop of California between Pacific and Atlantic ports would appear to indicate that this newer method of transportation must be studied with great care. Mistakes in one cargo should be corrected, and the only safe way is to use recording instruments.

Temperature and humdiity records for fumigation of orchards—One of the direct applications of the hythergraph for use in citrus orchards is its use in obtaining an automatic record of temperature and humidity simultaneously in the fumigating tents, in the trees, etc., all such exposures being subject to the usual field conditions requiring extreme portability combined with accuracy when used by field-foremen as well as county inspectors. It is believed by many that this application of the hythergraph will fill a long felt want.

Eye observations of air conditions are at best subject to considerable error, as they are often matters of personal equation, whereas automatic registration gives a dependable basis for investigation. It has the unquestioned advantage of giving continuous records of the chief meteorological elements to be studied, namely Temperature and Relative Humidity in an ffective, accurate and portable manner.

Acknowledgements—The writer acknowledges many valuable suggestions and material assistance in design and calibration of the hythergraph among them may be mentioned the aeronautic instrument section of the U. S. Bureau of Standards and the U. S. Air Service: the Mount Wilson Observatory Laboratory of the Carnegie Institution of Washington; the Pioneer Instrument Co.; Starr Engineering Corporation; and John V. Frederick.

SOME OF THE LOCAL WINDS OF THE WESTERN COAST OF NORTH AMERICA

BY FORD A. CARPENTER, D. Sc., LL. D., F. R. G. S.

Illustrated by the Author

Of all the interesting phenomena connected with weather on the sea and in the mountain districts of the western coast of North America none yields more readily to observation and study than the wind. Meteorologists, like other investigators and experimentalists in the realm of natural science, are always on the lookout for records of actual conditions which illustrate a well defined law. From the multitude of types of atmospheric movement, four examples are selected of general and three of local circulation.

Of the Pacific coast winds there are those directly associated with barometric gradients and others of more local origin such as the **Chubasco,** the "wooley" and the "Wilmington"* wind.

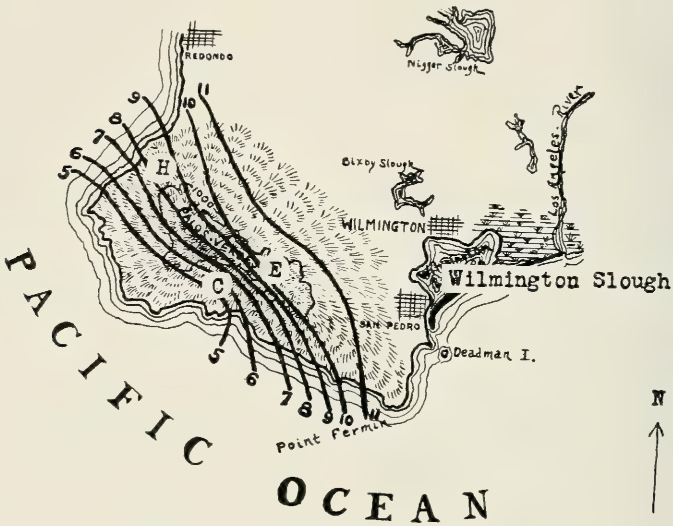


FIG. 8.

TYPICAL DISTRIBUTION OF WIND VELOCITIES

The lines show approximate wind velocities in miles per hour. The line of 11 miles per hour which extends from Redondo to Point Fermin is again repeated to the northeast. From this locality, however, the winds gradually decrease as the San Gabriel mountains are neared: the wind velocity at Los Angeles is 5 miles per hour. The letters ("E," "C," "H") refer to the meteorological stations on Fig. 9.

*It should be borne in mind that the "Wilmington wind," like the "Santa Ana wind," does not have its origin in the town of the same name. The "Santa Ana" originates from the Santa Ana canyon, and the "Wilmington" owes its nomenclature to a topographic depression (Wilmington Slough) northeast of Los Angeles Harbor (See Fig. 1.)

Of the mountain winds observed, there are those of glacial and avalanche origin which are herein briefly described and discussed. It is a matter of record that long before the advent of meteorologists and aviators, birds and sailors knew and took advantage of coast winds and mountaineers studied how to avoid the icy gales from glacier and avalanche.

Until the atmospheric vertical components were encountered by aviators, meterologists were dependent upon the horizontal measurements of anemometers; the existence of local winds in the southern littoral of California and Mexico has been long known, but until airplanes navigated the air, and increased numbers of anemometer stations made possible the charting of the lower currents, the cause, extent and effect of these local winds were all but unknown.

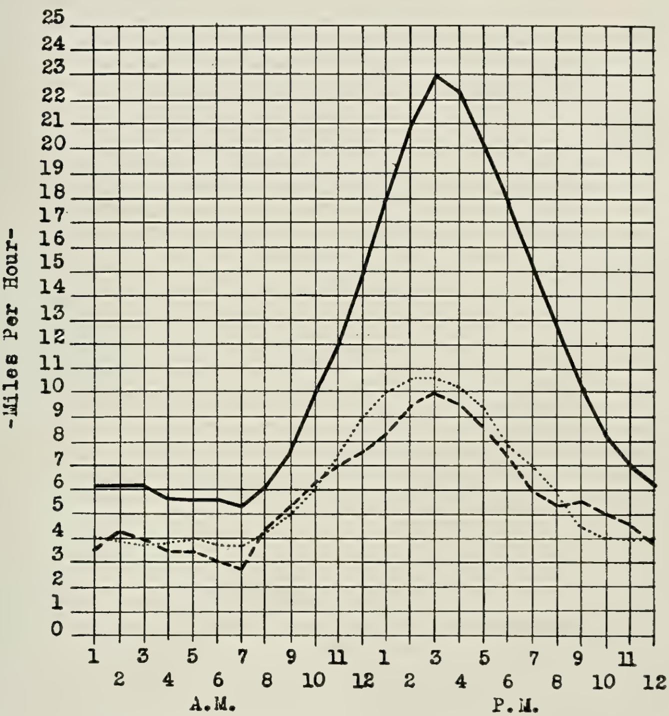


FIG. 2

COMPARATIVE SUMMARIES FOR MAY 1916

(All Data from Standard Anemometers, Weather Bureau Type)

	Palos Verdes Stations Sta. C	Sta. E	Sta. H	Los Angeles	San Pedro
Total Movement for Month (miles)	4290	7913	6397	4409	8232
Average Hourly Velocity (MPH)	5.8	10.5	8.6	5.9	11.5
Greatest Daily Movement (miles)	357	590	611	202	547
Movement (miles) and Date	24th	24th	24th	23rd	24th
Highest Hourly Velocity (MPH)........	26	....	....	26	39

Palos Verdes ("C") dotted line; Los Angeles, dashes; San Pedro, solid line. For location of stations see Fig. 8.

Of the winds of the coast of Central America, Mexico and California, the **chubasco,** the "woolly" and the "Wilmington" are among those best known by their effects, and least studied so far by meteorologists. Of avalanche and glacial winds attention has been given to them by travelers in Switzerland, South America and India and mountaineers in Alaska and in the Canadian Rockies have observed their effects and studied their causes.

The Chubasco—This is a storm wind accompanying some of the local disturbances of the southern coast of California and Mexico and is characterized by gusts of quickly varying direction. This wind is generally experienced in thunderstorms and always attains considerable velocity.

The history of the word chubasco begins with the log of the navigators of the fifteenth century; the ancient nautical term **chubazo** which defined a squall, has been replaced in the Spanish navy by the term **"chubasco"** and is now in general use among navigators of all nationalities on the lower California and Central American coast.

As is well known, the waters of the Pacific coast of southern California, Mexico and Central America are uniformly calm; the winds are light and storms infrequent. In fact, sailing craft should have auxiliary power on account of the prevailing calms in these waters. It is for this reason that squalls are notable occurrences and

PLATE 8.

MOUNT RAINIER, WASHINGTON
(Photographed by Ford A. Carpenter, July, 1900.)

According to the U. S. Geological Survey, Mount Rainier, in 1913 had an altitude of 14,408 feet above sea level. Owing to the variation in the thickness of the snowcap, this mountain is continually changing in elevation. This telephotograph was made from Vashon Island, Puget Sound, 55 miles north of the peak. The side of Rainier shown herewith has been little explored owing to its extreme ruggedness. Ascents and explorations are ordinarily carried out on the south, or opposite side of the Mountain.

PLATE 9.

AVALANCHE CONDITIONS SOUTHERN SLOPE OF MOUNT RAINIER
(Photographed by Ford A. Carpenter, August, 1916.)

The meteorological conditions depicted in this photograph followed a series of avalanches. The path of the more notable snowslides followed the course of the Nisqually glacier which is the most prominent glacier in the photograph. This photograph was made from the northern slopes of the Tatoosh range.

have been differentiated in a manner unknown on the stormy Atlantic coast. An interesting example of the velocity of the wind during a **chubasco** occurred during one of the voyages of the American steamship "Missourian," Captain William Lyons, master. This ship was caught in a **chubasco** and such was the force of the succession of squalls that she was compelled to lay to. Heavily laden with sugar and high-powered the ship was using full steam ahead. During the height of the **chubasco** the steamer's whistle sounded a long wailing blast. "Why did you signal?" asked the captain of the quartermaster. The man denied that he had touched the whistle cord. Shortly afterwards the whistle blew again and both men noticed that it was the pressure of the wind on the whistle cord that operated the valve. After the storm, the vessel's master found that under the same steam pressure it was possible to operate the whistle valve by placing an 18-pound weight in the middle of the 200-foot one-eighth inch steel cable which formed the whistle cord. From this experiment the master calculated that the wind during the **chubasco** exceeded 100 miles per hour in velocity.

The "Woolly"—The term "woolly" is applied to a descending wind in a local squall which churns up the sea in a flocculent manner. Flocculence is noted especially when a promontory deflects the wind upward and descends on a lee shore. Woollies have been observed at Cape Colnett off the Lower California coast, at Point Loma, and at Point Firmin, off the California coast.* The origin of the name "woolly" is interesting and the name is apt. The water is churned by the wind into isolated waves which look like tufts of wool. The downy, and wool-fine masses of water are often the first indications the yachtsmen have of proximity of these dangerous winds. The down-beating squalls have been known to carry away topsails from too closely venturing schooners. To airmen "woollies" are never failing signs of perilous air conditions in their vicinity. The history of the term "woolly" shows it to have been used by seafaring people of all of the southern coast in Europe as well as in America. The late Dr. Hector Alliot, the brilliant curator of the Southwest Museum, and sincerely mourned director of this Academy, once told the writer in a conversation on local weather conditions that "**'La mer moutonneuse'** describes the sea when it is foamy, fleecy like sheep—hence woolly. In Spanish **'el mar lanudo'** is a woolly, fleecy sea; a colloquial expression of fishermen in the Gulf of Gascony, is **'el mar carneruno' the sea resembling sheep."**

What is the vertical thickness of the "woolly"? For a decade and more the writer observed and studied this wind, but not until 1915 did an occasion present itself for its close acquaintance. In making some investigations of meterological conditions in an airplane at an elevation of 3,500 feet the writer directed the ship above the peninsula of Point Loma, and the note-book has the following entry:

"Carrying out my suggestion as to investigating the "woolly" the pilot drove the machine straight for Point Loma and those unseen aerial breakers. At an elevation of 2,000 feet we suddenly felt two distinct 'wallops' and I felt the fuselage beneath me respond as if struck by a stuffed club. There was evidently first a surge, then a drop, and it was the descending current of air that deprived the airplane of the supporting medium, hence the shock. Point Loma itself, from this altitude and seen directly from above, looked like

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*"Woollies" were encountered by the round-the-world airplane flyers of the U. S. Air Service on May 16, 1924, at Attu Island of the Aleutian archipelago, and greatly hindered their progress.

PLATE 10.

DESCENDING WINDS ON THE SOUTH SLOPE OF MOUNT RAINIER

(Photographed by Ford A. Carpenter, August, 1916.)

One of the most comprehensive views of Mount Rainier may be had from the summit of Pinnacle Peak (altitude 6,562 ft.). It was during midsummer of 1916 that descending winds on the south shoulder of Mount Rainier were made visible by cloud masses. The lowest altitude shown in this picture is 4,572, and Mount Rainier rises nearly ten thousand feet above that level in the five miles which separate the two mountains.

a barracuda backbone—long, low and ugly. Although this peninsula is less than 500 feet high it so effectively deflects the prevailing northwesterly wind that the upward surge has been noticed by aviators at an altitude of 4,000 feet."*

The "Wilmington" Wind—This is the appellation given the wind that sometimes sweeps northwesterly into Los Angeles Harbor from the north of Redondo Beach. During the past few years it has been possible to obtain continuous and reliable wind observations over much of the region. The Palos Verdes district thus meteorologically studied is situated between Los Angeles Harbor on the east and Redondo Beach on the west (See Fig. 8). As a further identification it may be stated that the coast of the Palos Verdes is some twenty-five miles south of Los Angeles. The plotting of the anemometrical records over the Palos Verdes coast and hills shows graphically the geographical limits, the rise, and diminution of the Wilmington wind (See Fig. 9). It probably reaches its greatest velocity at Wilmington Slough, and its width does not exceed 10 miles. The variation in the velocity of this wind is worth considering. Records from Wilmington are not available so the nearest station is used, that of Los Angeles Harbor, which is a sub-station of the United States Weather Bureau established by the writer in 1913 when he was official in charge of the Weather Bureau office at Los Angeles. This sub-station is southwest of Wilmington Slough. The time of the greatest velocity of wind is 3 P. M., there being a gradual increase in air movement from 6 miles per hour at 7 A. M. The wind decreases at a regular rate until midnight, when it touches 5 miles per hour. The charts and map (Figs. 8 and 9) are computed from the data for May, 1916. During that month the average velocity of the wind at Los Angeles Harbor was 12 miles per hour, as compared with half that velocity on the Palos Verdes coast and at Los Angeles. The maximum velocity of the wind on the coast (11 miles per hour) is attained at 2 P. M., and the minimum of 3 miles per hour, at 6 A. M. This, it will be observed, is different from the times of occurrences of the maximum and minimum at Wilmington. At Los Angeles the maximum wind occurs simultaneously with that of the harbor, only slightly less in velocity, but the minimum of 4 miles per hour occurs 4 hours later, or at 4 A. M. Another very interesting feature is the very narrow limits of the Wilmington wind. The chart of average wind velocity (Fig. 8) shows that the wind steadily decreases as the southern coast is approached. On the outskirts of the northern boundary of the Palos Verdes, the 200-foot topographic contour practically marks the curve of the maximum hourly velocity of 11 miles. The limitations of the chart shown as Fig. 8 does not permit the carrying out of the succeeding contours which diminish at a regular rate towards the northeast until the city of Los Angeles is reached where the wind decreases to a secondary minimum of 5 miles per hour. The first minimum, it will be remembered, was directly on the seacoast. It is also a fact that the increase of wind with altitude is more marked to the west of Wilmington Slough than to the east. The writer has found that flying over the western district towards Redondo Beach choppy and "bumpy" air has been noted when the altimeter registers four thousand and upwards. To the east of Wilmington the gusty nature of the wind is observed only below the 1000-foot level. Aviators have found that they may avoid the pernicious effects of this wind by flying only a few miles to the northeast or southwest of the locality where it debouches seawards east of Point Firmin.

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*The Aviator and the Weather Bureau: Ford A. Carpenter. Mt. Pleasant Press, Harrisburg, Pa. 1917. Pp. 19, 20.

PLATE 11

PATHWAY OF THE GLACIAL WINDS OF THE NISQUALLY

(Photographed by Ford A. Carpenter, August, 1916.)

Glacial winds sweep down the canyon of the Nisqually glacier with considerable velocity, at times equalling a gale. At Panorama point where this photograph was taken, the glacier is half a mile in width and the western edges have an altitude of 7,000 feet above sea level. Within the limit of view, as shown by the photograph, the glacier has a variation of 1,000 feet in altitude.

Glacial Winds — During the first decade in August, 1916, the writer made a number of observations of glacial and avalanche winds near the summit of Mount Rainier. Mount Rainier, it will be remembered, is situated in the northwest corner of the United States, in the state of Washington, on the shores of Puget Sound. Although the literature of mountaineering has many references to glacial and avalanche winds it is seldom that they have been studied by a meteorologist. Therefore the conditions under which the observations noted in this paper were taken, may not be without interest.

The writer spent five days and nights on or within a hundred yards of one of the largest glaciers in the United States. Living in such close proximity it was but natural that accompanying meteorological conditions should be readily studied. It is not generally known that not less than twenty-eight glaciers originate within a radius of ten miles from the peak of Mount Rainier. Eight of these glaciers have their birth at the summit of the mountain. One of the most spectacular is the celebrated Nisqually glacier, on which most of the observations were made.

Although Mount Rainier is but second in height to Mount Whitney (the highest mountain in the United States) it is second to none in impressiveness. On unclouded days the mountain is easily the most picturesque object in the northwest. Viewed from Puget Sound it rises majestically nearly three miles into the air. (See Pl. 8.).

The northern face of the mountain has never been scaled; nearly all of the ascents have been made from the south side of the peak.

Glacial Winds—It is from the southern slope of the mountain that the Nisqually glacier proceeds for a distance of about six miles. This glacier is about three-quarters of a mile wide at the widest part and flows through a self-carved valley, the walls of which reach a maximum height of one thousand feet. (See Pl. 11.) The mean wind direction was northerly throughout the period of observations which were made a short distance away from the glacier itself. Where observations were taken even a quarter of a mile distant from the glacier, on either side, the glacial drift of air was not noticeable. Owing to the lack of self-recording instruments it was not possible to determine the variation in hourly velocity, but eye observations showed that the wind attained greatest strength in the afternoon, confirming the general principles of air-drainage. During certain nights the downward trend of the air current was distinctly noted.

In traversing the glacier it was noticed that the glacial wind made a distinct obstruction in walking up stream. (See Pl. 12.) The air currents were variable in velocity and of constantly low temperature and high humidity. The strongest winds were between Panorama Point and the thousand foot cliffs on the opposite side. Other climbing parties reported these winds of so violent a nature as to make the ascent of the mountain very laborious, and, during much of the time experienced guides were detained at temporary camps on the face of the glacier by violent icy winds.

Avalanche Winds—Two avalanches were observed while in the Rainier district. Both occurred at three in the afternoon and the amount of snow displaced was estimated in one instance to have covered an area of three, and in another five acres (See Pl. 9 and 10). Both occurrences followed snowstorms of the night before. The time of the avalanches, with attendant winds, was within an hour of the daily maximum temperature of the afternoon. The roar of the avalanche sounded like railroad trains thundering along a canyon. The air that these masses of snow and rock push ahead of them was observed at a considerable distance, and their breath

was felt more than a thousand feet distant. Strangely enough it reminded one of the backward thrust of an airplane propeller from a stationary machine. In climbing over the rocky backbones ("cleavers") which separate the glaciers, the effect of avalanche winds on loose friable rock was observed. There were other occular proofs of the wind havoc in the groups of broken pine trees, pinyon cedars and other stunted growth with undamaged trunks and roots, but with broken and blasted limbs and branches, showing that the wind was the chief factor in destruction.

CYCLONIC WINDS

The mechanics of glacial and avalanche winds is comparatively easy to comprehend, for we have only a few factors to remember, and the story of their cause and effect Nature writes in large letters for us to read. Not so with the cyclonic winds; here we deal with unseen differences in air pressure and we have to rely on simultaneous readings of the barometer over a large area, for the air-waves which produce these winds are sometimes five hundred or more miles in diameter. One of the best examples of the cause and effect of storm winds occurred during the early days of December, 1923. Here is the account:

Cyclonic Winds—An example of relationship between barometric areas and wind—As a matter of fact, all winds result from barometric gradients, but data is seldom available to demonstrate it. On December 8, 9 and 10, 1923, southern California was visited by a severe

PLATE 12.

EFFECT OF GLACIAL WINDS

(Photographed by Ford A. Carpenter, August, 1916.)

The glacial wind was so severe at the time this photograph was made that it necessitated bending the body at a considerable angle to counteract the downward-driving, icy blast of air.

windstorm. It was the most notable storm that has been recorded in a generation in this district. The nearest approach to these high winds occurred in this vicinity 32 years ago. Winds such as the accompanying chart discloses are of common occurence in many other parts of the United States for it will be noticed that the maximum hourly velocity of the wind during this storm of several days did not exceed 28 miles per hour. It is to be remembered that winds exceeding an average of 10 miles per hour are so infrequent as to cause local comment; the records of the Weather Bureau indicate that on an average of five days in the year does the wind at Los

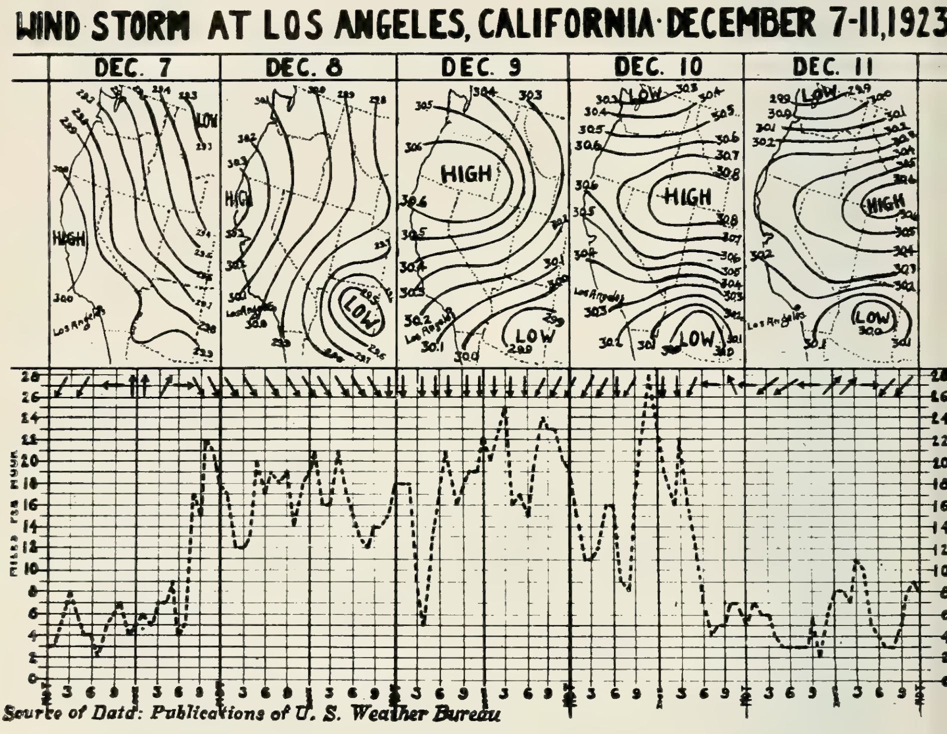

FIG. 10.

DIAGRAM ILLUSTRATING ACTUAL EXAMPLES OF RELATIONSHIP BETWEEN AREAS OF LOW AND HIGH PRESSURE AND DIRECTION AND VELOCITY OF WIND

The upper half of the diagram shows Pacific Coast sections of the morning daily weather map for five consecutive days. Beneath each map is a diagram showing the progressive variations in wind direction and velocity. The arrows fly with the wind, and the dotted curves represent fluctuations of wind velocity in miles per hour.

Special attention is directed to the second, third and fourth sections of the diagram as they graphically illustrate the actual flow of air from the HIGH to the LOW. The arrows under the second section show a distinct northwesterly drift, for the HIGH is northwest of the LOW. The arrows of the third section show a northerly drift with similar disposition of the pressure areas, while the fourth section depicts a northeasterly movement of the air from the HIGH to the LOW.

Angeles blow more than 25 miles per hour, while the average hourly velocity of the wind is 5.0 miles, and of the month of December, 5.1 miles. It is necessary to bear these facts well in mind to appreciate the unusual character of the winds of the three-day storm period which averaged 16 miles per hour, with a maximum hourly velocity of 28 miles per hour. In many other places such winds would be the usual afternoon program. In a locality then, where the imperturbability of weather is a by-word and the climate a matter of extraordinary evenness (but, it should be clearly borne in mind, with tremendous ranges within comparatively short distances) a study of the causes and effects of this windstorm will prove enlightening.

While the wind at Los Angeles was actually of moderate velocity it was relatively high, having a force of five or six times the normal. The wind was proportionately severe throughout the southwest; at Los Angeles Harbor the wind attained a velocity exceeding 60 miles per hour. Such was also the case at Newport harbor, part way to San Diego, and at Mount Wilson, where the anemometer was blown away and the wind record interrupted. Well-found and high-powered ships were forced to ride out the gales along the southern coast. The interior and mountain communities suffered from demolished electric power and communication lines. Land transportation in such districts was rendered almost impossible by the force of the wind; one instance is recorded of the wind impeding further progress of a powerful truck. When the throttle was opened wide the front wheels of the truck were lifted clear of the ground by the combined force of the wind and motor.

In order to understand the mechanics of the windstorm it is necessary to refer to Fig. 10. From the chart and diagram it will be seen that there is a truly remarkable agreement between the disposition of the isobars shown on the weather maps and the actual velocity and direction of the wind. The weather map depicts a portion of the North American coast of the United States east of the Rocky Mountains. Beneath each map is a graph showing the direction and velocity of the Los Angeles winds in bi-hourly periods. The arrows fly with the wind and thus show the prevailing directions; the lower half of the figure shows the variation in wind velocity in miles per hour.

A glance at the upper part of the chart shows that the weather map of December 7 indicated a dominating low over the greater part of the United States wtth the usual incoming high off the California coast. Over southwestern Arizona, however, the tell-tale "pocket" of low barometric pressure showed signs of forming. The wind was normal, as shown in the wind graph, both in its direction and velocity, exhibiting the usual effect of a combination of the valley-mountain, and land-and-sea breeze. At 8 P. M. of December 7th it will be noted that the wind suddenly increased to five times its normal movement, blowing steadily from the northwest. This continued during the next day, where the weather map of that date graphically shows the cause of both the change in direction and in the increase in velocity. The change in direction was occasioned by the shifting of the axes of the pressure area, and the increased velocity by the increase in the height of the high and the proportionate deepening of the low over Arizona. With this chart before one, it takes but little imagination to picture the winds blowing from the area of high pressure into the area of low pressure. This is an ideal circulation and one not always met with in weather maps; needless to say, the weather map that we are considering is of surface conditions. In the study of the pressure conditions of December 8th it will be noted that the high mover inland, still increasing in intensity, the low remaining practically stationary. This arrangement gave the very high winds a markedly northerly drift, for, it

will be remembered, the **high** was directly **north** of the low. On the 10th the **high** increased in intensity, and, on the next day the **low** gradually filled up. The **high** then moved further eastward and the winds dropped to nearly normal velocity and direction.

Unlike most weather maps, as students will testify, the windstorm of December 7-11, exhibited ideal relationship between areas of low and high barometric pressure and wind. Practical students of the daily weather map,—business men, farmers and air-pilots, having direct interest in drawing their own conclusions from these data may be benefited by perusal of this diagram. In it there is explanation in simplest form of the first principles of wind control by areas of barometric pressure.

NOTES ON THE IRREGULARITIES OF OCEAN CURRENTS

BY FORD A. CARPENTER, D. Sc., LL. D., F. R. G. S.

(With illustration by the author)

It is generally admitted by oceanographers that wind and sun are the causes of ocean currents. The most powerful cause of ocean currents is the wind. Among other contributing causes is the action of the sun on the tropical waters of the globe, increasing density by evaporation, thus leaving the water even more salty. In other localities within the limits of torrential downpours, heavy rains freshen the ocean; the difference between the heavy, salty water, and the lighter, fresher water is one of the causes of ocean currents. It is generally agreed, however, that whether it is the wind, or the varying densities of the water, it is doubtful if wave motion extends downward more than 500 fathoms. In other words, ocean currents may be considered to be surface drifts.*

Ocean currents are irregular in extent and velocity—Ocean currents are always irregular in position and speed; only in most exceptional instances may ocean currents be compared to rivers. Generally speaking, vast movements of seawater depend upon the time of the year, and the distribution of storms over the region. Meteorologists are not in agreement that ocean currents produce weather; rather, a majority believe that ocean currents are caused by weather. On the North Pacific coast of the United States, for example, during winters of unusual dryness, the absence of rain is always associated with steady north winds, and mariners during such seasons experience ocean currents **down** the coast. During wet winters, when the winds along the Oregon-Washington coast are from the south, shipmasters count on **up** currents, or a decided northerly drift. A decade or more ago, when vessels used to ply regularly between Puget Sound and

*The velocity of surface drift is found to be directly proportional to the wind producing it.—C. S. Durst, B. A., in "Relationship Between Current and Wind" Proc. Roy. Meteorological Soc. April, 1924, p. 116 Vol. 50.

Salinas Cruz, it was not unusual for a ship to experience a favoring current on the southern voyage, and, after a fortnight's discharge of freight in the Mexican port of Salinas Cruz, encounter a likewise favoring current on the northern voyage as well. Such a reversal of the drift of the water was occasioned solely by the fair weather north winds and the rainy south winds.

Severe storm winds and tidal waves change beach lines—High winds blowing shorewards throw up quantities of sand as do also tidal waves. In this way stretches of sand will wash away and the waves will deposit the sand at other places along the shore. The disintegrating effect of such wave action is shown all along the southern California coast. Plate 13, accompanying this article is an example of the disintegrating effect of wave action; it also shows in a very interesting manner the circular wave motion produced by a rocky island. Shortly after the great Japanese earthquake disaster of the autumn of 1923, changes in the shore line of the western coast of America were noticed. The shape and size of the beaches were thus changed overnight, accomplishing what would otherwise require years of ordinary tidal action. Such instances are rare and their effect is sporadic. The impulses of such wave motion is entirely incidental and have no relation whatsoever to ocean currents.

PLATE 13.

LONG POINT FROM POINT VINCENTE, PALOS VERDES COAST

(Photographed by Ford A. Carpenter, February, 1916)

The crest of the point as shown in the photograph, has an elevation exceeding 100 feet above mean tide, and the rocky pinnacle which is shown surrounded by water even at low tide, rises 30 feet above the water-level and 70 feet above the bottom of the sea.

Particular attention is directed to two things in this photograph; 1st, the spectacle of rapid disintegration by ocean current, and 2nd, the effect of a rock pinnacle in producing widening wave circles resulting from on-shore currents.

THE MARINE FISHES (TELEOSTEI) OF SOUTHERN CALIFORNIA†

(Continued from the February-March Issue of the Bulletin)

BY ALBERT B. ULREY

Director of the Marine Biological Station of the University of Southern California

and

PAUL O. GREELEY

Instructor in Biology, University of Southern California

EE. Pectoral fin entire. Slit behind fourth gill small or wanting.

F. Dorsal spines 8 to 17.

G. Anal spines 3; body scaly. .... **Scorpænidæ.**

GG. Anal spines obsolete; body partly or wholly naked....... .... **Cottidæ.**

EEE. Slit behind fourth gill large; body scaled.

H. Nostril single on each side, a small pore above it; dorsal fin continuous. .... **Hexagrammidæ.**

HH. Nostrils two on each side; dorsal fins two, separate, except in the genus Erilepis. .... **Anoplopomidæ.**

DD. Suborbital stay wanting, cheeks not mailed.

I. Spinous dorsal transformed into a sucking disk on top of head, composed of 8 to 30 transverse plates. **Echeneidæ.**

II. Spinous dorsal (if present) not transformed into a sucking disk.

J. Dorsal spines all or nearly all disconnected from each other.

K. Body oblong or ovate, compressed.

L. Caudal peduncle very slender, the fin widely forked; preopercle entire. .... **Carangidæ.**

LL. Caudal peduncle stoutish, the fin little forked.

M. Gill membranes broadly united to the isthmus; preopercle entire. .... **Ephippidæ.**

JJ. Dorsal spines (if present) all, or most of them, connected by membrane.

N. Pectoral fin with 4 to 9 lowermost rays detached and filiform. .... **Polynemidæ.**

NN. Pectoral fin entire.

O. Dorsal and anal, each with 1 or more detached finlets.

P. Anal preceded by 2 free spines............... **Carangidæ.**

PP. Anal not preceded by 2 free spines; caudal peduncle keeled. .... **Scombridæ.**

OO. Dorsal and anal without finlets.

Q. Lateral line armed posteriorly with a series of keeled plates; 2 free anal spines; gill membranes free from the isthmus. .... **Carangidæ.**

QQ. Lateral line unarmed.

R. Anal fin preceded by 2 free spines (these obsolete in the very old, joined by membrane in the very young).

S. Preopercle entire; teeth moderate if present. **Carangidae.**

RR. Anal not preceded by free spines.

T. Nostril single on each side, lateral line interrupted; lower pharyngeals united.

U. Anal spines 2.............................. **Pomacentridae**

TT. Nostril double on each side.

V. Lateral line extending to the tip of middle rays of caudal.

X. Anal spines 3, the second strong.

Y. Dorsal fin continuous........ **Haemulidae (Pomadasidae)**

XX. Anal spines 1 or 2, the second large or small. . **Sciaenidae**

VV. Lateral line not extending beyond base of caudal fin.

Z. Gills 3½, the slit behind the last very small or wanting.

a. Mouth not verticle, the lips not fringed; dorsal fin continuous, the spines 8 to 18; scales cycloid; lower pharyngeals united.

b. Teeth distinct or nearly so, the anterior usually more or less canine.............................. **Labridae**

ZZ. Gills 4, a long slit behind the fourth.

c. Teeth setiform, like the teeth of a brush; body elevated; longer than deep, the soft fins completely scaled; gill membranes attached to the isthmus.

d. Dorsal fin divided.......................... **Ephippidae**

cc. Teeth not setiform.

e. Body longer than deep.

f. Gill membranes broadly joined to isthmus, body long and low; no lateral line.......................... **Gobiidae**

ff. Gill membranes free from the isthmus or nearly so.

g. Premaxillaries excessively protractile, their basal processes very long, in a groove at top of cranium.

h. Teeth small; scales large silvery; spines strong. **Gerridae.**

gg. Premaxillaries moderately protractile or not protractile.

i. Lower pharyngeals united; scales large; anal fin with three spines and more than 15 soft rays; preopercle entire. (Viviparous fishes of the California fauna)..... .... **Embiotocidae**

ii. Lower pharyngeals separate.

j. Body other than elongate, compressed, or covered with hard grooved scales.

k. Lateral line incomplete or interrupted, running close to dorsal fin; dorsal spines very slender, continuous with the soft rays; body low, covered with small scales; anal fin very long.

l. Anal rays more than 30; Maxillary not produced behind .... **Bathymasteridae**

m. Pseudobranchiae wanting or covered by skin. Dorsal fin of soft rays, only beginning as a crest on the head; caudal widely forked. Pelagic fishes... **Coryphaenidae**

mm. Pseudobranchiae developed.

n. Spinous dorsal of 2 or 3 short spines only; anal without spines; scales small, smooth............... **Serranidae**

o. Dorsal fin continuous, the spines few, slender; maxillary usually with an enlarged tooth behind; nape sometimes with an adipose appendage; anal fin long, even..... .... **Malacanthidae**

oo. Dorsal fin continuous or divided, not as above.

p. Perch-like fishes, the caudal peduncle not very slender, scales well developed, ctenoid or cycloid; the dorsal with distinct spines, the anal with at least one spine, its soft rays usually few.

q. Anal spines 3, never 2 nor 1; dorsal fin continuous or divided.

r. Vomer, and usually palatines also, with teeth.

s. Anal fin shorter than dorsal; head not everywhere covered with rough scales; postocular part of head not shortened .... **Serranidae**

t. Fishes carnivorous; teeth in jaws not all incisor-like.

u. Vomer with teeth, these sometimes very small; maxillary long .... **Lutianidae**

uu. Vomer without teeth; palatines and tongue toothless.

v. Teeth on sides of jaw not molar; maxillaries formed essentially as in the **Serranidae**; preopercle mostly serrate .... **Haemulidae (Pomadasidae)**

tt. Fishes herbivorous; anterior teeth in jaws incisor-like; no molars or canines; premaxillaries moderately protractile .... **Kyphosidae**

pp. Mackerel-like fishes, with the caudal peduncle usually very slender, the fin widely forked, the scales various, usually not ctenoid; the dorsal spines various, anal fin long.

w. Dorsal spines mostly low, not more than 2 of them filamentous.

x. Dorsal fin very long, all the rays soft; skeleton soft.... .... **Icosteidae**

xx. Dorsal spines 3 or 4, the fin not divided.

y. Scales rather large, firm; body broad, ovate, the shoulder girdle very strong......................... **Bramidae**

BB. Body scaleless, smooth or armed with tubercles, prickles or scattered bony plates.

C. Breast with a sucking disk.

D. Gill membrane free from the isthmus; no spinous dorsal; large sucking disk between the ventral fins......... .... **Gobiesocidae**

DD. Gill membrane joined to the isthmus; a sucking disk formed of the ventral fins.

E. Skin perfectly smooth; spinous dorsal not distinct.... .... **Liparididae**

CC. Breast without sucking disk.

F. Gill membranes broadly attached to the isthmus.

G. Ventrals completely united.................... **Gobiidae**

FF. Gill membranes nearly or quite free from the isthmus.

H. Anal preceded by 2 free spines (these lost with age; connected by membranes in the very young)..**Carangidae**

HH. Anal without free spines.

I. Dorsal and anal fins followed by finlets....... **Scombridae**

II. Dorsal and anal without finlets.

J. Suborbital with a bony stay; no free anal spines.... .... **Cottidae**

AA. Gill openings small in or behind lower axil of pectoral fins, which are more or less pediculate; mouth large; head compressed; no pseudobranchae.... **Antennariidae**

3. Ventral Fins Present, Thoracic or Jugular, the Number of Rays Not Definitely 1, 5.

A. Eyes unsymmetrical, both on the same side of head.

B. Eyes large, well separated; edge of preopercle usually evident .... **Pleuronectidae**

BB. Eyes small, very close together; edge of preopercle hidden by skin; mouth very small.............. **Soleidae**

AA. Eyes symmetrical, one on each side of the head.

C. Ventral rays with or without spine, the number of soft rays more than 5.

D. Caudal fin wanting; scales spinous.......... **Macrouridae**

DD. Caudal fin well developed.

E. Tail isocercal, the vertebrae progressively smaller to base of caudal; ventrals jugular; no spines in any of the fins.

F. Jaws and vomer with strong canines; second dorsal and anal deeply notched, no barbel............ **Merlucciidae**

EE. Tail not isocercal, the last vertebrae not reduced in size.

G. Ventral rays about 15, dorsal fin single, elevated..... .... **Lampridae**

GG. Ventral rays I, 6 to I, 10; dorsal with spines.

H. Dorsal fin continuous; spines 2 to 8; chin without barbels.

I. Suborbitals narrow, not covering the cheeks; opercular bones usually spinous; pseudobranchia present....... .... **Berycidae**

(To be Continued in the July-August Issue of the Bulletin)

ZYGADENUS DIEGOENSIS n. sp.

DR. A. DAVIDSON

Plant rather stout, 4 dm. tall; bulb ovoid 20 mm. thick; basal leaves 5 or 6, all sheathing at base, 3 dm. long. 9 mm. wide, smooth, not scarious at margin; stem leaves 2; bracts herbaceous, narrow, attenuate; pedicels 2-2.5 cm. long, erect in fruit; perianth segments white, 5 mm. long, 2 mm. wide, broadly ovate, truncate at base; claw 1 mm. long, yellow; gland with upper margin toothed and ill defined; stamens equalling the perianth; capsule 12 mm. long.

Type No. 3592. Palomar Mts., San Diego Co.

The original bulb was gathered by F. Fultz and cultivated by R. Kessler, the description given is from this cultivated specimen.

This plant differs from **Z. venenosus** Wats. in possessing leaves quite smooth, bracts herbaceous instead of membranaceous and gland ill defined above instead of well defined.

All recent floras have accredited **Z. venenosus** to San Diego Co. Presumably this plant has been confused with the species above as the typical **Z. venenosus** while common enough in the north has not been found in Los Angeles or the neighboring counties.

A CORRECTION

At the foot of page 60 of our last issue, in Campbell and Davidson's article on "Aphidophagous Syrphidae" the following lines were omitted: "matured in 34 days, while the third larva, which had daily access to abundant food supply, consumed 167 and matured in 16 days."

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"	16,	"	2.	July,	1917	1.00
"	17,	"	2.	July,	1918	.75
"	18,	"	1.	January,	1919	1.00
"	18,	"	2.	July,	1919	.75
"	19,	"	1.	January,	1920	.25
"	19,	"	4.	October,	1920	.25
"	20,	"	1.	April,	1921	.25
"	20,	"	2.	August,	1921	.25
"	20,	"	3.	December,	1921	.25
"	21,	"	1.	March,	1922	.25
"	21,	"	2.	October,	1922	.25
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Los Angeles, California.

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A PRELIMINARY REPORT ON THE PARASITIC ENEMIES OF THE CITRICOLA SCALE

[*Coccus pseudomagnoliarum* (Kuwana)]

WITH DESCRIPTIONS OF TWO NEW CHALCICOID PARASITES.

By

HAROLD COMPERE

University of California, Citrus Experiment Station.

ABSTRACT

The so-called citricola scale has been found by Clausen to be synonomous with *Coccus pseudomagnoliarum* (Kuwana). In California this scale is preyed upon by at least four species of primary parasites, which are the same species attacking *Coccus hesperidum* Linn. The latter scale is held in check almost entirely by these parasites and it is the opinion of the writer that their lack of effectiveness on the citricola scale is due to the fact that *pseudomagnoliarum* has but one generation per year while *hesperidum* has several. Several *hyperparasites* are found in connection with the soft brown scale. Biological notes and descriptions of two new parasites are given.

According to Mr. C. P. Clausen, the citricola scale was first described by Dr. S. I. Kuwana as **Lecanium pseudomagnoliarum** from specimens taken at Oji near Tokyo, Japan.[2] In the same year, 1914, supposedly the same species was described by Mr. Roy Compbell as a new scale from California and given the name **Coccus citricola.** Clausen has placed the name **C. citricola** in synonymy and the name now stands as **Coccus pseudomagnoliarum** (Kuwana). Professor H. J. Quayle states that in California this pest was first noticed in Claremont in 1909, and at about the same time near Riverside and in certain sections of San Bernardino county. In recent years the citricola scale has greatly extended its range, and has become very abundant, so that it now ranks as one of the major pests of the citrus in the interior districts of southern California, and in certain citrus areas of central California it takes first place.

In California the citricola scale is preyed upon by at least four species of internal parasites. According to previous records and our rearings there are **Aphycus luteolus** Timb., **Microterys flavus** (How.), **Coccophagus lecanii** (Fitch), and **Coccophagus lunulatus** How.

One is immediately struck by the fact that this aggregation of parasites is the same complement which in California effectively controls the soft brown scale **Coccus hesperidum** Linn. The soft brown scale is an insect from which the citrus grower of today has little to fear, yet in the early days of citrus culture it is said to have been

[1]This paper is a result of work carried on while the writer was in the employ of the California State Department of Agriculture.

[2]The Citricola Scale in Japan, and its Synonymy, C. P. Clausen, Journal of Economic Entomology, Vol. 16, No. 2, p. 225, April 1923.

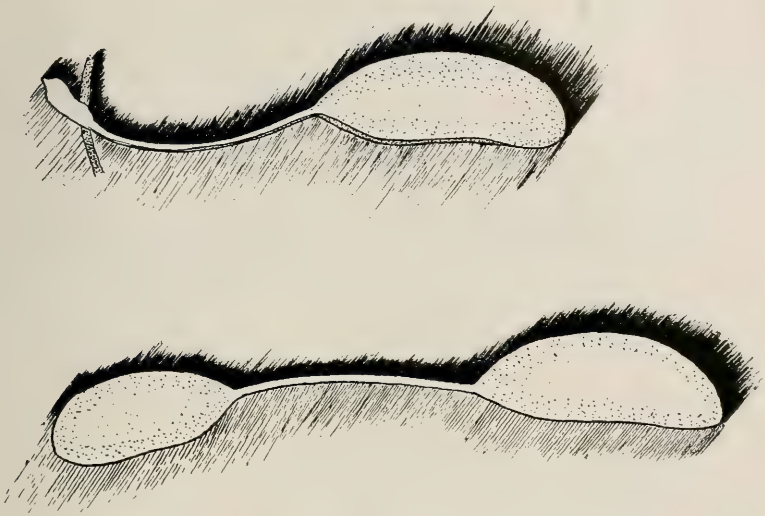
Figure 1.

Anicetus annulatus Timb. Female.

one of the worst pests and to have vied in destructiveness with the black scale, **Saissetia oleae** (Bern.) The question immediately arises, if the soft brown scale is held in check entirely through the influence of parasites, why is not the citricola, a cogeneric host favored by the same parasites also controlled? If what we have learned regarding the seasonal history of the black scale in its relation to that of the parasites can be used as a basis for comparison one explanation may be offered. So far as we know, the parasites of the soft brown and the citricola scales, like those of the black scale, cannot long survive a dearth of suitable-sized hosts. The scales may be present in enormous numbers, but if they are of a size rendering them invunerable to attack they cannot be utilized as food by the parasites. At certain seasons of the year they are immune to certain of their enemies because of their small size, not containing enough substance to nourish the parasitic larvae to maturity. Later their large size and toughened derm makes them unattractive to some of their parasites. To our knowledge, none of the parasites are capable of attacking the scales in all of their different life stages, each parasite showing a marked predilection for certain sizes.

In southern California with its even, temperate climate, the parasites are active throughout the entire year if provided with the proper host material. The only difference is, that in the winter months their growth is slower, and the adults are not so active, but at no season is their activity entirely suspended. If the parasites have the ability to long survive a dearth of suitable-sized hosts, this fact has not been recognized. With some species it appears, however, that such is the case, for at certain seasons some parasites suddenly appear in considerable numbers just at the time when their hosts become vulnerable. In the case of the species under consideration, a dominating number of parasites accumulate only as the result of uninterrupted multiplication. In the absence of suitable-sized scales in which

Figure 2.



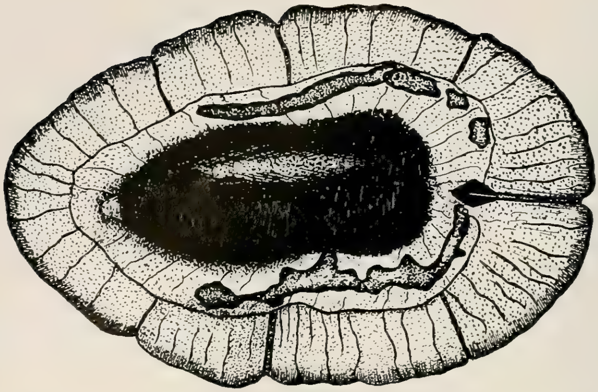
Newly laid egg with tip of stalk projecting through integument of host and the egg before oviposition.

to propagate they perish after a month or so, without having laid their quota of eggs.

Bearing in mind the limitations of the parasites, the seasonal life history of their hosts must be considered. The soft brown scale produces three or four annual generations, the hatch of young being very uneven and the different broods overlapping, so that the various stages of the pest are always present at any season of the year. When working on an infestation of this sort, the parasites always find some of the scales of a proper size to nourish their larvae, and a continuous increase of parasites usually results. In the case of the soft brown scale, the parasites when once given a start propagate continuously, finally reaching dominating numbers and producing satisfactory natural control. In comparison, the citricola scale matures only one annual generation, and the development of the brood is more or less uniform, so that the scales are all parents at the same time, and the young grow up together.

When working on an infestation of citricola scales, the parasites able to prey only upon individuals of about a certain size, are placed under a handicap, for the nature of the food supply permits only a limited period for propagation each year. When the scales become vulnerable the parasites commence to increase, but before they accumulate in sufficient numbers to control the pest, the scales develop an immunity by reason of their increased size, or by passing into the younger stages, as the case may be. At times the parasites of the citricola scale become rather abundant, but not soon enough to result in satisfactory control. What has just been stated applies to the conditions and parasites which exist in California. In Japan the conditions may be different, as the citricola scale is comparatively scarce, supposedly due to the influence of parasites. A careful study of the seasonal history of the citricola scale in Japan in its relation to that of its parasites would probably result in showing

Figure 3.



Characteristic appearance of a palm scale Eucalymnatus tessellatus (Signoret) when inhabited by the pupa of Anicetus annulatus Timb.

just what to expect from the establishment of the Japanese parasites in the California fauna.

In 1913 a preliminary study of the California parasites of **Coccus hesperidum** was made by Mr. P. H. Timberlake, who reared them on the soft brown scale.* The life history of these parasites when attacking the citricola scale is supposedly the same as when attacking the soft brown scale. **Aphycus luteolus** Timb., mentioned by Timberlake under the name **Aphycus** sp. near **flavus** How., holds first place as an enemy of the citricola scale in California. **Coccophagus lecanii** (Fitch) is probably entitled to second place, followed by **Coccophagus lunulatus** (How.) and **Microterys flavus** (How.). A fifth species **Aphycus alberti** (How.) mentioned by Timberlake as **Aphycus** n. sp. in his paper and said to be extremely rare, has recently been reared in considerable numbers from the soft brown scale in Pasadena. It seems likely that this species will be found working on the citricola scale also.

There are several hyperparasites in the local fauna which will probably prove detrimental to certain of the parasites of the citricola scale if they ever become very abundant. Timberlake records six hyperparasites, four of them obligatory internal parasites of Microterys and Aphycus. The other species, one determined as **Perissopterus javensis** How. and the other **Pachyneuron** sp., were reared from the soft brown scale but their host was not determined. Mention is also made of an **Anicetus** sp. which was taken at Sacramento. According to Mr. Timberlake it is the parasite mentioned as **Anicetus annulatus** Timb. in this paper. In addition to Timberlake's record, **Tetrastichus blepyri** Ash. can be listed as one more species actually reared from the soft brown scale. All of these hyperparasites, and probably many more, will undoubtedly attack their hosts when inhabiting the citricola scale as well as they do when they locate them in the soft brown scale. Some of the hyperparasites mentioned by Timberlake under their generic names have since been described, and

*Preliminary Report on the Parasites of **Coccus hesperidum** in California. P. H. Timberlake, Journal of Economic Entomology, Vol. 6, No. 3, June, 1913.

Figure 4.

Aphycus orientalis n. sp. Female.

a new genus has been erected for one of them. The list of hyperparasites brought up to date is as follows: **Quaylea whittieri** (Gir.), **Eusemion californicum** Comp., **Eusemion longipenne** Ash., **Cheiloneurus inimicus** Comp., **Tetrastichus blepyri** Ash., **Perissopterus javensis** How., **Pachyneuron** sp.

For the past two years, the Bureau of Pest Control of the California State Department of Agriculture has been attempting to introduce into California additional natural enemies of the citricola scale. With this idea in view, a request was made that Mr. C. P. Clausen, of the Bureau of Entomology, United States Department of Agriculture, who is stationed at Yokohama, Japan, be on the lookout for any natural enemies of the citricola scale which might occur in that country. As a result of this request, Mr. Clausen has made several shipments of parasitized scale material to California. From this material four different species of primary parasites have been reared, namely, **Coccophagus yoshidae** Nakayama, **Anicetus annulatus** Timb., and the two species described as new in this paper, **Aphycus orientalis** n. sp., and **Coccophagus japonicus** n. sp.

ANICETUS ANNULATUS TIMB.

Mr. Timberlake has informed me that **Anicetus annulatus** is the species referred to in his paper on the parasites of **Coccus hesperidum** in California (**loc. cit.**). In a later paper Timberlake described the

species as new, and supplemented the description with the statement that an examination of the host remains indicated that this species is unquestionably a primary parasite.* The description was made from specimens reared from the tessellated palm scale, **Eucalymnatus tessellatsu** Sig.

The first specimens of Anicetus, obtained by me issued from **Coccus hesperidum** infesting a small Aralia plant. This plant was taken from the Taiyo Maru, a Japanese steamer plying between the Orient and San Francisco. The plant, which was a decorative fixture of the boat, was observed by a horticultural quarantine officer who noted that the scales which infested it were parasitized. At the Whittier laboratory, where the plant was sent, ten females and several male Anicetus issued. These parasites were carried through three generations at the laboratory, but with each generation there was an increase in males, while the females decreased, despite the fact that they are given an opportunity to mate. This strain finally perished when only males issued. At a later date a few males and females were reared from **Coccus hesperidum** and **Coccus pseudomagnoliarum,** received from C. P. Clausen, Yokohama, Japan. A few pairs were liberated on soft brown and palm scales on plants at the Huntington Estate, San Marino, California.

A few observations were noted when handling this parasite in the laboratory. Although very meager, it seems worth while to publish them, as our knowledge of coccid parasites accumulates so slowly.

OVIPOSITION

A few palm scales, Eucalymnatus tessellatus, were placed in a vial with a female Anicetus. The parasite made the usual preliminary examination by palpating the scales with her antennae. During the inspection the antennae were swayed from side to side, sweeping the victim. At last, after making at least a dozen preliminary inspections, and exploratory insertions with her ovipositor, she was seen to deposit an egg. The victim was a small waxy semi-transparent individual. When about to oviposit, the parasite stands over her victim and extrudes the ovipositor, which easily penetrates the derm. In all cases this female selected the smaller stages of the scale. The time which elapsed from the insertion of the ovipositor to withdrawal was about one minute.

THE EGG

The ovarian eggs are double-bodied, consisting of two bulbous enlargements connected by a long slender neck or stalk, and are quite similar to the ovarian eggs of other Encyrtids such as Microterys, Aphycus, Blastotrix, etc. After deposition the newly laid eggs are located in the mid region of the scale, each suspended by a long stalk the tip of which protrudes through the derm. When the egg hatches the larva probably utilizes this stalk as an air line. The body of the egg is elongate oval, in lateral view the dorsal side is slightly convex and the under side slightly concave. They measure .15 mm. in length by .055 mm. in width. The suspending stalk is slightly longer than the bulb.

THE LARVAL AND PUPAL STAGES

The larval stages were not observed further than that they brought about a blackening of the hypodermal tissue in the mid dorsal

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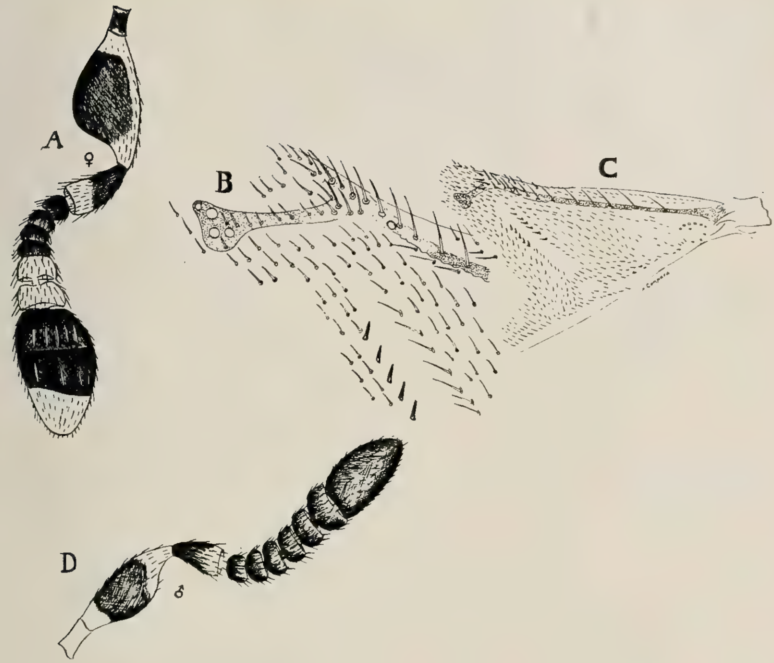
*Observations on the Source of Hawaiian Encyrtidae. P. H. Timberlake, Proceedings of the Hawaiian Entomological Society, Vol. 4, No. 1, pp. 227-231, June, 1919.

Figure 5.



Aphycus orientalis n. sp. Female. A—Antenna; B—Stigmal vein of forewing; C—Basal portion of forewing, male; D—Antenna

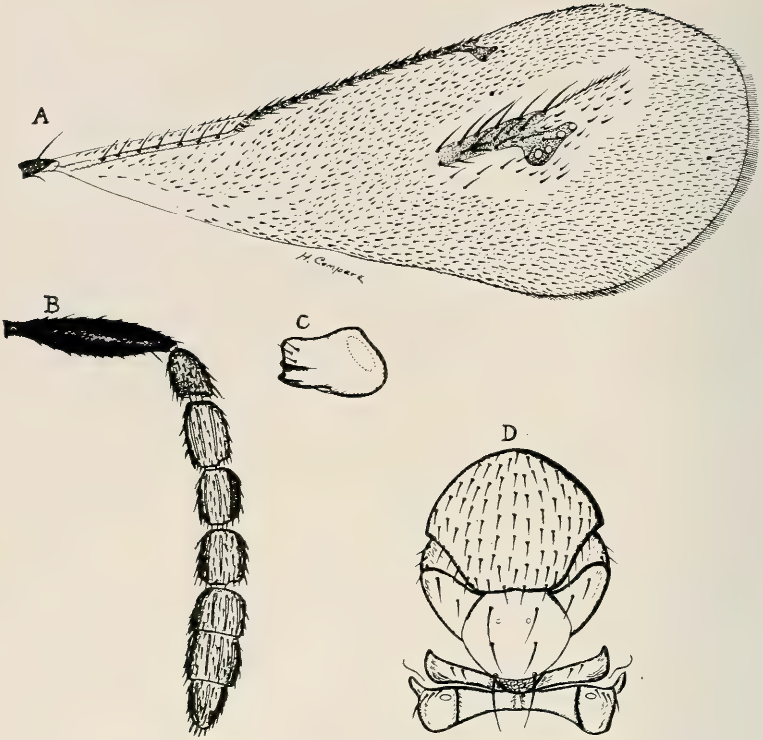
region of their hosts. This is a characteristic of **Coccophagus lecanii** and the new species described in this paper. No observations were made on the pupae. They are easily located lying face downward under the black-pigmented areas. The value of this parasite as an enemy of the citricola scale is doubtful. It has never been taken in California, except on one occasion by Timberlake, and it was the least abundant of the parasites inhabiting the citricola and soft brown scales received in the shipments from Japan.

COCCOPHAGUS YOSHIDAE NAKAYAMA*

This is a large black species with the legs partly marked with yellowish brown. It was originally described from specimens reared from **Cocus hesperidum** taken in the vicinity of Shizuoka, Japan. Several adults issued from citricola and soft brown scales received from Japan, all being of the female sex. These did not reproduce at the laboratory, although given an opportunity to work under what were supposedly ideal conditions. One female was observed in the act of oviposition; she selected a "rubber-sized" black scale in preference to some soft brown scales which were near. The method of procedure was similar to that of the other species of Coccophagus which have been studied. An examination of the host remains received from Japan indicate that this species is a primary parasite.

*Specimens determined by A. B. Gahan and P. H. Timberlake.

Figure 6.



Coccophagus japonicus n. sp. Female. A—Forewing; B—Antenna; C—Mandible; D—Thorax.

APHYCUS ORIENTALIS N. SP.

I am indebted to Mr. P. H. Timberlake for determining the species herein described as new. In a letter under date of October 3, 1922, he also states that this species can be separated from a somewhat similar undescribed species from China by the scutellum, which in this species is as wide as long by actual measurement, while in the undescribed Chinese specimen the scutellum is wider than long. In Timberlake's key** to the species of Aphycus the female of this form runs to **californicus** How. Timberlake has also verbally informed me that **californicus** How. as well as **oregonensis** How. are synonyms of **pulvinariae** How. The female of this species, although quite similar to **pulvinariae** in coloration, is very distinct structually, the antennae being proportionately wider. In **pulvinariae** the club is one-half as wide as it is long, and from one-fourth to one-third wider than the preceding funicle joint; while in this species the club is almost two-thirds as wide as long, and one-half wider than the preceding funicle joint. The club of **pulvinariae** is only as long as the last four or five funicle joints combined, while in this form it is fully as long as all the

**Revision of the Parasitic Hymenopterous Insects of the Genus Aphycus Mayr. with Notice of Some Related Genera. P. H. Timberlake, Proc. U. S. National Museum, pp. 588-590, May 31, 1916.

funicle joints combined. Also, in this species the scape is wider, it being fully one-half as wide as long, and as wide as the club. In comparison the scape of **pulvinariae** tends to be less than one-half as wide as long, but as wide as the club, which is more slender. The male form runs best to **oregonensis,** from which it greatly differs in both structure and coloration.

Female

Frontovertex very slightly more than twice as long as wide; ocelli arranged in an acute-angled triangle, the posterior pair about one-half their own diameter from the eye margins, and about one and one-half times their diameter from the occipital margin, the median ocellus placed in the center of the frontovertex; antennal scape expanded below, widest just beyond the middle, one-half as wide as long, as wide as the club; pedicel as long as the first three funicle joints combined, measured across greatest thickness as wide as the fourth funicle joint; first four funicle joints of nearly equal length and all gradually increasing in width distally so that the fourth is almost one-third wider than the first, the fifth longer than the preceding and about one-fourth wider, the sixth longer and wider than the fifth and twice as wide as the first; club broadly ovate, more than one-half wider than the preceding funicle joint, as long as all the funicle joints combined (fig. 2a). Wings uniformly ciliated; the oblique hairless streak interrupted below, the cut-off portion separated from the basal hairless streak by about two rows of irregular cilia (fig. 2b, c).

Coloration—Front, vertex and mesonotum orange yellow with slight infusion of brownish; face and cheeks paler yellow merging to pallid; the latter with blackish-brown blotch of variable degree extending from the base of the cheeks upward and more or less merging with the dark coloration of the occiput, tegulae, underparts ,and collar of the pronotum sordid white, except as follows: tegulate with a brown spot on the posterior margins, collar of pronotum with a blackish-brown dot on either corner, and the venter of the abdomen dusky; occiput broadly across the center, concealed part of the pronotum, the metanotum, propodeum, and dorsum of the abdomen blackish, the latter fading to soiled white on the sides behind the vibrissae. Antennal scape shining black, with the base, apex and a narrow line on the dorsal margin whitish; base of pericel black, the apex whitish; first four funicle joints, and first two joints of the club blackish brown, last two funicle joints and apical joint of the club brownish yellow. Legs in ground color similar to the whitish underparts; middle tibia, at either extremity, slightly tipped with brownish black, a more or less interrupted annulus of the same color on the upper third, and another less well defined but of greater extent on the lower third; the corresponding coloration of the fore and hind tibia faint, sometimes obsolete on the forelegs; last tarsal joints tipped with dusky.

Male

Antennal scape less than one-half as wide as it is long, as wide as the club which is considerably narrower than that of the female; the first four funicle joints subequal in length, the fifth almost one-half longer than the fourth, the sixth one-fourth longer than the fifth, all gradually increasing in width so that the sixth is twice as wide as the first, and about one-fourth wider than the preceding; club elongate, hardly wider than preceding funicle joint, rather pointed at apex, about as long as the last four funicle joints taken together. (fig. 2d). Length 0.7 mm. to 0.9 mm.

Coloration—Vertex, occiput broadly across the upper half, dorsum of the thorax and abdomen black; frons orange yellow; face,

cheeks and inferior half of the occiput chrome yellow to pallid; oral margins framed in dusky cheeks with a black blotch extending from near oval margin upword behind eyes merging with dark coloration of vertex and occiput; pronotum yellowish on sides with a black blotch near either corner; mesoscutum, propodeum and lateral sides of the abdomen behind the vibrissae brownish orange yellow; tegulae yellow with a black blotch on the outer posterior corners. Scape of antennae somewhat like that of female; base of pedicel black, apical half yellow; funicle and club blackish brown. Legs similar to those of female excepting the dark coloration, which is not so well defined.

Described from ten females and five males (type, allotype, and paratypes) found in the debris of shipping boxes, received June 5, 1922, from Mr. C. P. Clausen of Yokohamo, Japan.

Biological Note

Specimens obtained from **Coccus pseudomagnoliarum** (Kuwana) and **C. hesperidum** (Linn.) received as noted above. An inspection of the host remains resulted in the finding of two scales containing remnants of the parasites, and in one cell a well preserved adult clearly determinable. The old shells exhibited a honeycombed interior like that of a mature black scale (**Saissetia oleae**) when inhabited by several **Aphycus lounsburyi**. The scales were large individuals, which in life probably contained an abundance of ovarian eggs at the time of attack. The interiors were partitioned off by membranous walls forming individual pupal cells. In the pupal chambers thus formed the castings were found, and in one case an adult which had failed to issue. The other parasites had emerged through a number of exit holes which perforated the dorsum. One of the shells exhibited evidence of secondary parasitism, the pupal cases of some black species occupying the cells formed by the Aphycus larvae. However, this may have been only accidental parasitism, the usurper having been a Coccophagus of essentially primary habits. If speculation may be permitted on the basis of this evidence, it seems the mode of development **Aphycus orientalis** must follow very closely that of its congener **Aphycus lounsburyi** Howard, thus assuring strict primary parasitism.

COCCOPHAGUS JAPONICUS N. SP.*

This form is briefly characterized for the purpose of recording its introduction into California from Japan and to establish its place of origin should it later be recovered from this state. It is with hesitancy that specific rank is accorded this form as in all structural characters known to me it resembles **C. lecanii** (Fitch), it being separated merely on the basis of the difference in coloration of the legs. **C. lecanii** is subject to considerable variation in color and a large series from different parts of the world may reveal intergradations which will necessitate synonymizing this species or at least reducing it to a geographical variant. In addition to the twenty-five museum specimens from which the characterization has been drawn more than four-hundred living adults were handled, all of these being separable at a glance from the specimens of **lecanii** which have so far been taken from California. In coloration this form resembles **C. lunulatus** How. but is easily distinguished by the vestiture of the scutellum, the latter having a number of scattered hairs, while in this form the scutellum is clothed with only three pairs of strong bristles.

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*In a letter under date of July 18, 1922, Mr. P. H. Timberlake stated that apparently this is a new species.

Female

Posterior two-thirds of the scutellum yellowish, the remainder of body blackish; antennal scape blackish, the funicle and club fuscous brown; all coxal joints with some blackish, sometimes entirely black; trochanters pallid; hind femora blackish, the extremities yellowish white; apical tarsal joints dusky; remainder of legs usually entirely yellowish white; in a few specimens the femora and tibiae of the forelegs are in part slightly fuscous, the suffusion being more pronounced on the femora.

Holotype and two paratypes to be deposited in the U. S. National Museum, also, a series of three paratypes to be deposited in the Museum of the California Academy of Science in San Francisco, California.

Described from 25 females (holotype and paratypes) reared from **Coccus pseudomagnoliarum** (Kuwana) and from specimens found dead in the debris of shipping boxes, received June 2, 1923, from C. P. Clausen, who presumably, collected the material in the vicinity of Yokohama, Japan. Specimens of this species were obtained from an earlier shipment made by Clausen but no specimens retained.

In the larvel stages and in the mode of development this species seems to resemble **C. lecanii** very closely. The derm of the parasitised host takes on the characteristic black pigmented appearance. Some four hundred adults were colonized in several districts of southern California as a result of Clausen's shipment. Whether or not they have become established is not known at this writing.

BUTTERFLIES OF CALIFORNIA

By JOHN A. COMSTOCK, M. A., M. D., F. E. S.

Continued from May-June Issue

The Whites and Allies

GENUS PIERIS

The *MUSTARD WHITE*, (*Pieris napi. L.*) is a remarkable species for the number of distinct geographic races and seasonal forms which it has developed during the course of its evolution. No less than sixteen of these are recorded for America, north of Mexico, of which five occur in California. To these we add a sixth, as noted at the end of this paper.

The species is of some economic importance in the fact that the larvae feed on turnip and cabbage. The favorite food-plants, however are the Mustards and Toothworts, and the species is never sufficiently abundant to be a menace. Two or more broods of each race usually occur,—the earliest to emerge from overwintering chrysalids showing heavier markings and lineations.

The *PALLID WHITE* (*Pieris napi pallida, Scud.*) is a race occuring in the northern coastal region, distinguished by its nearly immaculate superior wing surfaces in the male. The female shows a slight barring of the veins in the apical area, and usually a round spot below the third median vein and a bar along the inner margin of primary. The under surface in both sexes shows a slight powdering along the veins in the basal and discal areas. Figures 15 and 16 of Plate VIII show the upper and under surfaces of the male, and Figure 17 depicts the under side of the female. This form may be taken in the late spring and early summer.

The *MARGINED WHITE* (*Pieris napi marginalis, Scud.*) is a large northern form occuring on the Oregon border that shows a narrow distinct veining on the under surfaces, and a fine narrow, almost indistinguishable marginal line on the upper side, completely encircling the wings. The basal area on upper surface is more heavily marked than in the preceding species. It is an early spring butterfly. Plate IX, figures 1 and 2 will serve to identify the male. Marginalis is a rare form that is represented in few collections.

The *VEINED WHITE*, (*Pieris napi venosa, Scud.*) is the most boldly and clearly marked of all our California races of napi. The figures 3 to 5 on plate IX will serve to identify it. Unfortnately two of our labels were transposed in the plate. Figure 3 is the upper surface of the female, and figure 5 the under surface of the male. This form occurs from central California northward, and is never common. It is an early spring butterfly.

REAKIRT'S WHITE, (*Pieris napi castoria, Reak.*) is a large, lightly marked form, representing the second brood, emerging in the late spring and early summer. The immaculate under surfaces, and, in the male, the discrete points on the upper side of primaries will serve to distinguish this race, which is accurately depicted in figures 6, 7 and 8 of Plate IX. Reakirt's White occurs in the same territory as the preceding form.

HARRIS' WHITE. (*Pieris napi oleracea, Harr.*) has been rarely met with in the Sierras. Lightly marked specimens are difficult to separate from the Pallid White, but the typical examples are more

heavily shaded along the veins on the under side of secondaries, and are lightly penciled in the same areas of the upper surface. The female particularly is heavily shaded above, along the nervules, and has a heavy band on the posterior border of the primaries. This race is shown on Plate IX, figures 9, 10 and 12.

A new race, differing markedly from any thus far described occurs in a restricted area of Sonoma County. I have called this the *SMALL VEINED WHITE.* It may be technically described as follows:

PIERIS NAPI MICROSTRIATA, race nov.

MALE. Superior Surface.

Primaries: ground color white. Costae heavily powdered with black scales in the basal area and at the apex. Extremity of all nervules heavily shaded with black, expanding toward margins and thus creating conical points, which are largest at the apex and diminish to a mere point at the first median nervule. Base heavily shaded. A broken submarginal line is suggested, most heavily accented below the third median nervule where it is formed into a round black spot. A similar, though fainter spot occurs below the first median nervule.

Secondaries: ground color white. A minute black point at outer angle. Basal area heavily shaded. Minute black points at ends of nervules. A suggestion of grey shading follows the nervules, due to the heavy lineation of the under side showing through.

INFERIOR SURFACE.

Primaries: ground color white, shading to delicate yellow near apex and outer margin. Nervules clearly margined with brownish black scales, on which the nervule itself forms a fine yellow line causing the lineations to appear as double narrow bands heaviest at apex and posterior margin of cell.

Secondaries: ground color lemon yellow. All nervules heavily bordered with brownish-grey, and, as on primaries, appearing as double lines. A bright orange dash appears on the basal portion of costa.

FEMALE.

Marked much as in the male, but with heavier shading in the basal area of primaries, and a broad band following the posterior margin to a point of juncture with the spot below first median nervule.

Head, black. Eyes, reddish brown. Antennae, black, tipped with yellow. Thorax, black with delicate grey pile. Abdomen, grey above, white below.

Holotype; expanse 39 mm. Taken at Eldredge, Sonoma County, California, March 13, 1911, by J. August Kusche.

Allotype; expanse 40 mm. Taken at same locality and on the same date by Mr. Kusche.

Paratypes; one male—same locality and date.

In collection of Southwest Museum.

The types and cotype No. 1 are accurately pictured on Plate IX, figures 12, 13 and 14, to be subsequently published in the Bulletin.

Calochortus lanternus n. sp.

Stem somewhat flexuous, branching, glaucous; basal leaves lanceolate, acuminate, 3-5 dm. long, 10-30 mm. wide; bracts foliaceous, acuminate, 5-15 mm. long; flowers subglobose, nodding on slender pedicels; sepals 25 mm. long, more or less acuminate, greenish-white; petals white (occasionally rosy) ovate-lanceolate, 3-5 cm. long, 20 mm. wide, incurved and strongly arched, clothed above the gland with white hairs; gland crescent shaped with 4 transverse upwardly imbricate scales; anthers oblong 5 mm. long; capsule 25 mm. long, short beaked; seeds white. Type No. 3596. Fish Canyon, San Gabriel Mts. were noted. The northern species from which the original description of *C. albus* was drawn has a much smaller flower, has a fringe of pink hairs above the gland and the latter is shaped like the segment of an oval. In *C. lanternus* the gland is shaped like a Turkish crescent; the capsule too is longer and has not the somewhat quadrate shape of *C. albus*. This plant is known locally as the Fairy lantern.

Allium grandisceptrum n. sp.

Bulb round about 1.5 cm. long with a very thin outer coat without definite reticulation; scapes 2.5-3 dm. high, sometimes in pairs, terete or occasionally slightly 2-edged; leaves 3 or 4, flat, 6-8 mm. wide and form from Placerville and cultivated them other points of difference that species in having white seeds. Mr. F. Burlew called my attention to this and when Mr. R. Kessler secured specimens of the northern about 2 dm. long; umbel open, 15-20 flowered; pedicels 20 mm. long; perianth pink or light rose colored, the outer segments 12 mm. long, 6 mm. wide, lanceolate, acute, the inner about half as wide; stamens 2/3 the length of the perianth; filaments all slightly dilated at base, the alternate ones less so; pistil 4 mm. long, stigma single; ovary smooth with rounded lobes.

Type No. 3595. Garberville, Humboldt County. Bulbs collected at this locality by Mrs. W. W. Hutchinson and cultivated here. This same species has been cultivated by Mr. R. Kessler, the bulbs having been collected in the Tehachapi Mts.

In general appearance this plant resembles *A. bisceptrum*. It differs in showing larger perianth segments, bulbs without reticulation and fruits without crests. It likewise shows the first leaf as a brown sheathing structure about 25 mm. long without any blade. Whether this is a characteristic of this plant or is common and usually overlooked on account of its withering early I have not observed sufficiently

This has hitherto passed as *C. albus* Dougl. but it differs from to render an opinion.

ADDITIONS TO THE LOCAL FLORA

Clarkia xantiana Gray. This plant hitherto unknown south of the Tehachapi has been collected by R. J. Dobbs near the Colby Ranch in the Tuhunga, May 1924.

Mimulus Breweri (Greene) Coville. Bear Valley.

DR. A. DAVIDSON.

SOUTHERN CALIFORNIA PLANT NOTES—II.*

PHILIP A. MUNZ

Unless otherwise indicated all specimens cited in this paper are in the C. F. Baker Herbarium of Pomona College.

Cupressus Forbesii Jepson. Madrona 1:75. 1922.

Our native cypress of Southern California differs from *C. guadalupensis* Wats. in having ascending branches without drooping branchlets. The foliage is juniper-green and not glaucous, the bark is cinnamon-brown rather than grayish-brown. This cypress, for which three stations have been published, all of them in San Diego Co. (Jepson, l. c.; Parish, Bull. So. Cal. Acad. Sci. 13:11-13. 1914 is to be reported also from Orange County. Here it grows abundantly on the west side of the Santa Ana Mts., in the second large side-canyon south of the Orange-Riverside County line, which is crossed as one drives down the Santa Ana River Canyon. Specimens from this canyon are: *W. M. Pierce, March* 10, 1922; *Munz & Johnston* 5566; and *Munz* 7327. The trees grow in alluvial soil on the canyon bottom and on the upper slopes of the canyon, and extend over a distance of at least a mile and a half. In habit and choice of habitat, the colony agrees well with Parish's description of the grove at Tecate Mt. (Parish, l. c. ; Saunders, Bull. So. Cal. Acad. Sci. 15:21. 1916). The largest tree seen was between 30 and 40 feet high; the crown is usually conic and peaked. The branches begin near the base and are slightly ascending, and form a crown from two-thirds to three-fourths as broad as high. The wood is brittle and splits easily. On May 18, 1922 the trees were with abundant fruit. Several years previous to this visit a fire had killed most of the trees in the upper and more narrow parts of the canyon, and at the time of the visit, the old dead trees were still standing and holding cones. However, seedling trees, many of which were five or six years old and as many feet high, occurred in great numbers.

Orcuttia californica Vasey. Bull. Torrey Bot. Club 13:219. 1886.

The first collection for Southern California, and the third for the species, was made in Menifee Valley, 10 miles northeast of Murietta, Riverside County, in May 1922, *Munz & Johnston* 5375. The grass was locally abundant and covered an area of about an acre on the bottom of a dessicating winter pool.

Allium obtusum Lemmon. Pittonia 2:69. 1890.

A form of this onion is locally abundant on gentle stony slopes on the north edge of Thomas or Garner Valley in the San Jacinto Mts., about two miles north-west of Kenworthy, *Munz & Johnston* 5512, First collection south of the Tehachapi Pass, according to Dr. Abrams, who kindly identified the collection (Illus. Flora Pac. States 1:388. 1923). The plant is distinguished from the other montane Alliums of Southern California by its broad, oblong and obtuse perianth lobes.

Calochortus flexuosus Wats. Am. Nat. 7:303. 1873.

Specimens with the characteristic sinuous stems of the species, were found by M. French Gilman on rocky slopes in a high gorge in the Chuckwalla Mts. on the Colorado Desert, *Munz & Keck* 4838. This collection extends the range southward some 200 miles, the nearest known station being in the Death Valley Region.

*The first paper in this series appeared in the Bull. So. Calif. Acad. Sci. 22:7-11. March 1923.

Nolina Parryi Wats. Proc. Am. Acad. 14:247. 1879.

Locally abundant in the chaparral of the coastal slopes of the Santa Ana Mts.; Santa Ana River Canyon, *Munz & Johnston* 5315, & *Munz* 7329; Modjeska's Ranch, *Munz* 7728; and extending on south into Trabuco Canyon. Reported from the eastern slopes of the same range by Parish (Muhlenbergia 7:73. 1911, and Erythea 7:90. 1899). These plants of Orange County tend to have a less well developed claw on the perianth-lobes and shorter style than do plants from the desert. These characters, however, seem too inconstant for nomenclatorial recognition. In fruit and habit of growth, the coastal and desert plants seem quite similar.

Eriogonum nodosum Small. Bull. Torrey Bot. Club 25:49. 1898.

Not only in the eastern parts of the Mohave Desert as given by Jepson (Fl. Calif., 416. 1914), but common for miles in the desert region along the north base of the San Gabriel Mts., growing on open stretches and ascending the washes to 4,500 ft. alt., as at Sheep Creek, *Munz* 7720, where it grows with *E. Heermannii* D. & H. It was blooming abundantly on Sept. 1, 1923 with a characteristic growth-habit of erect stems and storied horizontal branches bearing white flowers.

Tetragonia expansa Murr. Comm. Goetting 6:13, t. 5. 1783.

Well established on the beaches of Los Angeles and Orange Counties, as at Hermosa Beach, *Feudge* 52, and Laguna Beach, *Munz* 7321. Previously reported from Santa Barbara by Parish (Bull. So. Cal. Acad. Sci. 19:15. 1920).

Silene verecunda Wats. Proc. Am. Acad. 10:344. 1875.

Jepson (Fl. Calif., 508. 1914) refers to the northern *S. verecunda* much of our southern material. Study of our plants in the field leads me to follow his treatment and to refer to the species such plants as are low and compact in growth, mostly not more than 2 dm. high, with fairly compact inflorescence, and with leaves from 2-6 mm. wide. For the most part such plants occurring in Southern California have a purplish cast, and the petal-blades are frequently almost as broad as long. Here I would refer such collections as the following: Little Baldy, San Gabriel Mts., at 9,500 ft., *Munz* 6119; Mt. San Antonio, at 9,000 ft., *Johnston* 1671, at 9,250 ft., *Peirson* 2284; Ontario Peak at 8,000 ft., *Johnston* 1528; Blue Ridge, Swartout Valley, at 8,450 ft., *Munz* 7683; and San Gorgonio Peak, from 11,000 to 11,500 ft., *Munz* 7596. The collections by Johnston and by Munz from Mt. San Antonio and Blue Ridge are quite canescent; the others all heavily glandular.

Silene verecunda var. *platyota* (Wats.) Jeps. Fl. Calif., 509. 1914.

To the var. *platyota* belong the more slender and open light green plants, ranging from 2-5 dm. high, and with leaves mostly 2-3 mm. wide. The petal-blades are usually distinctly much longer than wide. These plants frequent lower altitudes for the most part and extend further south: Mt. Pinos, 7,000 ft., *Munz* 7045; Vincent Gulch, San Gabriel Mts., 6,500 ft., *Munz* 6842; Swartout Valley, 6,700 ft., *Munz* 7704; Bear Valley, San Bernardino Mts., 6,500 ft., *Harwood* 4316; Deep Creek, *Abrams* 2039; South Fork of Santa Ana River, 8,200 ft., *Munz* 6246; Tamarack Valley, San Jacinto Mts., 9,200 ft., *Munz* 6401; Idyllwild, 5,400 ft., *Spencer* 1607 *July* 9, 1921, and 2184; Keen Camp, 5,000 ft., *Munz* 5772; Santa Rosa Mts., 6,500 ft., *Munz* 5844; Pine Hills, San Diego Co., 4,200 ft., *Spencer* 1607, *June* 24, 1920; Santa Ana Mts., 5,000 ft., *Munz & Keck* 7074; Cuyamaca Mts., 5,000 ft., *Munz & Harwood* 7278.

Glaucium flavum Crantz. Stirp. Austr. 2:131. 1763.

This immigrant can now be reported from California. On May

22, 1923, it was found well established on the south side of Lake Elsinore, *Dr. H. Baer.*

Diplotaxis tenuifolia (L) DC. Syst. 2:632. 1821.

Santa Ana, Orange Co., *Johnston* 1927 in May, 1918; and between Tustin and Santa Ana, *J. Vaile in Jan.*, 1924. Growing as a vigorous weed with 12 to 20 stalks from one root. Reported by Parish for Los Angeles Co. (Bull. So. Cal. Acad. Sci. 19:18. 1920).

Eruca sativa Mill. Gard. Dict. Ed. 8, No. 1. 1768.

A few plants on a vacant lot on "H" St., San Bernardino, April 8, 1923, *J. B. Feudge.* First Southern California record.

Parnassia californica (Gray) Greene. Pittonia 2:102. 1890.

Occasional in the San Bernardino Mts., in wet meadows along the South Fork of the Santa Ana River, at about 8,000 ft. alt., *Munz* 6269. An excellent match for material from the Sierras, and quite distinct from *P. cirrata Piper,* our other southern species, in lack of fringe on the petals and in the larger flowers and oblong rather than subcordate leaves. I have seen specimens of *P. cirrata* from both the San Bernardino Mts. (Vivian Creek, *Munz* 7615) and San Gabriel Mts. (Coldbrook, *F. Grinnell Jr. in* 1917).

Sibbaldia procumbens L. Sp. Pl. 284. 1753.

The first record for Southern California is from the Foxesee Creek in the San Bernardino Mts., at 9,000 ft. alt., *F. W. Peirson* 3492.

Polygala Fishiae Parry. Proc. Davenport Acad. Nat. Sci. 4:39. 1884.

Apparently widely distributed over the coastal drainage in scattered stations. Aside from the localities mentioned for Ventura and Los Angeles Counties by Abrams (Fl. Los Ang., 211. 1917) and Davidson & Moxley (Fl. So. Calif., 216. 1923), I have seen material from several additional stations: West Fork, Matilija Canyon, Ventura Co., *Hall* 7843 (Univ. Calif. Herb. & Pomona); Rincon Creek, Ventura Co., *Baer in* 1922; Temecula Canyon, Riverside Co., *Munz* 7127; Dulzura, San Diego Co., *Valentine in* 1903, *Stokes in* 1901, and *Mrs. Hagenbock* (all three at Univ. Calif.).

Ceanothus papillosus T. & G. Fl. No. Am. 1:268. 1838.

Locally abundant in dense chaparral at about 3,250 ft. alt. on the trail from Holy Jim Canyon to Santiago Peak, on the Orange County side of the Santa Ana Mts., *F. W. Peirson* 3492. The previously reported range of this species is from the Santa Lucia Mts. northward. Our material agrees well with that from the north, though somewhat less pubescent.

Cornus Nuttallii Audubon. T. & G. Fl. No. Am. 1:652. 1840.

This species has a wider distribution in Southern California than is commonly realized. It is credited to the San Bernardino Mts. in many references (Abrams, Bull. N. Y. Bot. Gard. 6:429. 1910; Parish, Pl. World 20:247. 1917; Davidson & Moxley, Fl. So. Calif., 267. 1923; Sargent, Man. Trees No. Am., 788. 1922). Others add to this range the San Jacinto Mts. (Sudworth, Forest Trees Pac. Slope, 415. 1908; Jepson, Univ. Calif. Mem. 2:271. 1910; Hall, U. C. Pub. Bot. 1:99. 1907). It can now be reported from the San Gabriel Mts., where two trees were found in Cascade Canyon at 4,400 ft. alt., *I. M. Johnston. June* 28, 1924. In the Palomar Mts. it is common in Doane Valley, *Munz* 8245, and in the Cuyamaca Mts. it occurs on the trail to Cuyamaca Peak, at 6,200 ft., *Munz* 7257.

Pyrola asarifolia var. *incarnata* (Fisch.) Rhodora 6:178. 1904.

A large colony, with its plants scattered over perhaps half an

acre, was found on Aug 22, 1923 by F. W. and Mabel Peirson and myself; it occurred on the wet banks of a springy hillside at 8,000 ft. on Vivian Creek in the San Bernardino Mts., *Munz* 7593. First record for Southern California.

Pyrola minor L. Sp. Pl. 396. 1753.

First found in Southern California in moist places along the stream below Dollar Lake, San Bernardino Mts., *Peirson* 2587 in 1920. It occurs there fairly plentifully at 8,900 ft., *Munz* 6239, and along the edge of wet meadows on the South Fork of the Santa Ana River at 8,700 ft., *Munz* 6189. Occasional also in the San Jacinto Mts., at the base of trees and on moist banks at the edge of the meadow in Round Valley, *Munz* 6049 and 6395.

Pyrola secunda L. Sp. Pl. 396. 1753.

This Pyrola can also be reported from Southern California, having been collected, as long ago as 1906, at 6,700 ft. on Lost Creek in the San Bernardino Mts., *J. & H. H. Grinnell* 330 (Cal. Acad. Herb.). It occurs sparingly in Round Valley in the San Jacinto Mts., at 9,000 ft. on the raised edge of a wet meadow, *Jaeger* 1171 and *Munz* 6396.

Trichostema lanatum Benth. Lab. Gen. & Sp. 659. 1835.

The typical form of the species, as pointed out by Abrams (Bull. Torrey Bot. Club 34:265. 1907) is a coastal plant. Coming from the north into our range, it extends south at least into San Diego Co. and is characterized by a narrow woolly thyrsus, with flowers 10-15 mm. long and stamens 30-40 mm. long, and by a tendency to a heavy white tomentum on the under side of the leaves. It is represented from Southern California by such specimens as: Sespe Creek, Ventura Co., *Dudley & Lamb* 4787; Saugus, *Hall & Chandler* 7404; Mint Canyon, *Peirson*, 176; Topango Canyon, *Munz & Harwood* 3997 and *Hitchcock* 12; Santa Ana River Canyon, Orange Co., *Munz* 7328; Del Mar, *Spencer* 2266; and San Diego Co., *Brandegee in* 1898.

Trichostema lanatum var. *denudatum* Gray Syn. Fl. 2:459. 1886.
T. Parishii Vasey. Bot. Gaz. 6:173. 1880.

The inland form, the var. *denudatum*, has a more open and less woolly inflorescence, with flowers 8 to 10 mm. long, stamens 17-24 mm. long and the leaves scarcely or not woolly below. It ranges from the San Gabriel Mts. eastward and southward, and in its extreme form is quite distinct from the species. A study of a series of specimens convinces me that it is only varietal in rank, many plants approaching the species in one or more characters, for example such collections as: San Antonio Canyon, *Johnston* 2041; Cajon Pass, *Munz, Johnston & Harwood* 4079; Foxesee Creek, San Bernardino Mts., *Munz* 6315; San Jacinto Mts., *Hall* 2155; Warners Springs, *Mrs. Coombs in* 1915. More typical of the variety are: City Creek, San Bernardino Mts., *Johnston & Williams* 2936; Mill Creek, *Crawford;* Hemet Valley, San Jacinto Mts., *Munz* 5819; Santa Rosa Mts., *Munz* 5825; Laguna Mts., *Spencer* 155; Ramona, *Purpus in* 1899; between Jacumba and Campo, *Abrams* 3692; Alpine, *Munz & Harwood* 7149.

Mimulus Clevelandi Brandegee. Gard. & For. 8:134. 1895.

Though this has been known only from the mountains in eastern San Diego County, it is common along trails and in cleared places on dry slopes in the chaparral belt of the Santa Ana Mts. The plant is extremely viscid and is only very slightly frutescent. On the Orange County slopes it is common at from 3,200 ft. to 5,200 ft. along the trail from Holy Jim Canyon to Santiago Peak, *Munz* 7768. On the Riverside County slopes it is common at about the same elevations on the Glen Ivy trail to Santiago Peak, *Munz* 7062.

Pedicularis semibarbata Gray. Proc. Am. Acad. 7:385. 1868.

This species, which is so common in the pine belt of our mountains, has interesting ecological relations. On August 31, 1923 along the high ridge between Swartout Valley and the Prarie Fork of the San Gabriel River, I had opportunity to make some observations on its habits. At that season whenever the leaves were plucked from a plant, they all came off together and apparently had been cut off from the fleshy caudex. This was true of plant after plant; the cut ends were brown and healed over, and in most cases the rather thick leaves had not yet wilted.

Great numbers of seedlings were everywhere visible, having cotyledons and from one to three leaves. Careful digging of these showed a remarkable development of root-system for one season, the rather fleshy whitish roots going into the soil, almost without branching for some 8 to 10 inches, and generally ending in a firm attachment to roots of *Pinus ponderosa* or *Abies concolor*. Search failed to reveal many plants at any distance from pines or firs, indicating apparently that its distribution is determined partly at least by its opportunity to form the semiparasitic relations with the conifers.

Penstemon Clevelandi Gray var. *Stephensi* (Brandegee) Munz & Johnston. Bull. Torrey Bot. Club 49:41. 1922.

The varietal status of *P. Stephensi* Brandegee (Bull. Torrey Bot. Club 50:215. 1923) as insisted on by Munz & Johnston (Bull. So. Cal. Acad. Sci. 23:36. 1924) is supported by specimens recently received from Mr. E. C. Jaeger, collected by him in 1923 at Keyes Ranch in the Little San Bernardino Mts. It will be remembered that *Stephensi* is known only from the eastern part of the Mohave Desert and *Clevelandi* from the western edge of the Colorado Desrt. These specimens coming from the border line between the two deserts are intermediate in character. They agree with the former in the grayish cast of the plant, in the size and color of the flowers, and in the jagged-serrate condition of the leaves. They are like typical *Clevelandi* in the absence of connate-perfoliate leaves; and like the var. *connatus* in having a bearded sterile filament. The whole inflorescence is much more strongly glandular-pubescent than in any other specimens that I have seen for the whole group. Representing a combination of characters as they do, they confirm me in my opinion that *P. Stephensi* is not a distinct species.

Parishella californica Gray Bot. Gaz. 7:94. 1882.

A rarely collected plant, but apparently fairly well distributed on the Mohave Desert. The type locality is Rabbit Springs. A fine collection was made in May, 1922, two miles south of Crutts Postoffice, where it was locally abundant in gravelly soil, *Johnston* 6576.

Anaphalis margaritacea (L) B. & H. Gen. 2:303. 1873.

Hall, reviewing the reported occurrence of this species in Southern California, was forced to the conclusion that all such reports were based on misdeterminations (U. C. Pub. Bot. 1:115. 1907). It was reported in 1922 from Barton Flats, San Bernardino Mts., by Davidson (Bull. So. Cal. Acad. Sci. 21:27). We also now have undoubted specimens from a narrow side-canyon which is tributary to Mill Creek Canyon in the San Bernardino Mts. This canyon is on the south side of Mill Creek and about one mile east of Forest Home. It is very narrow and precipitious and in its upper parts has much loose talus. It was in such a situation at about 6,200 ft., that *A. margaritacea* was found by F. W. and Mabel Peirson and myself in August 1923, *Munz* 7603. It occurred in a few scattered colonies and had the fairly narrow, revolute ascending leaves of the typical form.

Lepidospartum latisquamum Wats. Proc. Am. Acad. 25:133. 1890.

L. striatum Coville. Proc. Biol. Soc. Wash. 7:73. 1892 and Contr. U. S. Nat. Herb. 4:140. *pl XI.* 1893.

This species can now be reported from our region, two collections having recently been made: Swartout Valley, San Gabriel Mts., at 6,650 ft., Sept. 1, 1923, *Munz* 7,700; and Lone Pine Canyon, San Gabriel Mts., at 5,300 ft., *W. M. Pierce on Oct.* 15, 1923. It forms a broom-like, irregularly tufted, erect shrub, 5 to 6 ft. high, and grows in dry, rather gravelly places with such plants as *Artemisia tridentata* and *Chrysothamnus nauseosus* var. *viridulus* Hall.

Lygodesmia spinosa Nutt. Trans. Am. Phil. Soc. N. S. 7:444. 1841.

The first report of this species in Southern California can now be made. A small plant, not in flower, but with the characteristic tuft of wool at the base, was collected by Peirson in 1922 in the Swartout Valley region. A visit on Aug. 30 and 31, 1923 to the same region by Peirson and myself, resulted in our finding it fairly abundant on dry slopes and ridges both north (at 7,300 ft. *Munz* 7665) and south (at 8,450 ft., *Munz* 7670) of Swartout Valley. On the north ridge it was associated with such plants of the pine belt as *Eriogonum microthecum* Nutt. (*Munz* 7661), *E. umbellatum* var. *stellatum* Jones, *Galium multiflorum* Kell. var. *parvifolium* Parish. On the south ridge occur *Eriogonum pusillum* T. & G. (*Munz* 7676) and *E. Parishii* Wats. (*Munz* 7680), both unknown previously in the San Gabriel Mts.

Senecio occidentalis (Gray) Greene. Pittonia 4:122. 1900.

The first collection made in Southern California was by F. W. and Mabel Peirson and myself, *Munz* 7590, near the summit of San Gorgonio Peak in August 1923. There it is locally abundant about rocks from 11,000 ft. to 11,400 ft. along the trail from Vivian Creek. Det. by Greenman.

THE MARINE FISHES (TELEOSTEI) OF SOUTHERN CALIFORNIA†

(Continued from the May-June Issue of the Bulletin)

BY ALBERT B. ULREY

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and

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CC. Ventral fins with or without spine, the number of soft rays fewer than 5.

J. Gill opening before the pectoral fin.

K. Anal fin present; caudal fin not directed upward.

L. Upper jaw not prolonged into a sword.

M. Dorsal fin with some spines or simple rays.

N. Dorsal fin without soft rays, composed of spines only.. .... **Blenniidae**

NN. Dorsal fin with soft rays anteriorly, with spines posteriorly; gill membranes joined to isthmus..... **Zoarcidae**

NNN. Dorsal fin or spines anteriorly, with soft rays posteriorly.

O. Dorsal spines connected by membrane.

P. Suborbital with a bony stay, extending across the cheek, to or toward the preopercle, the cheek sometimes entirely covered with a coat of mail.

Q. Pectoral fin not divided.

R. Body entirely covered with an armour of bony plates; head bony.................................... **Agonidae**

RR. Body naked, or more or less rough or scaly, not entirely covered by bony plates.

S. Gill opening large, extending downward nearly or quite the lowest pectoral ray....................... **Cottidae**

PP. Suborbital without bony stay.

T. Dorsal spines 2 to 4 only; head very broad, depressed; gills 3; gill membranes broadly united to the isthmus.

U. Ventrals not reduced each to a single spine. **Batrachoididae**

TT. Dorsal spines numerous; gills 4.

V. Gill membranes separate, free from the isthmus.

* Body greatly elongate; lower jaw with a slit at base to permit free motion; lips not fringed. Soft dorsal and anal without anterior lobe; continuous with spinous part .... **Lepidopidae (Trichiuridae)**

VV. Gill membranes broadly united, attached to the isthmus or not.

W. Gill openings moderate or large.............. **Blenniidae**

MM. Dorsal fins of soft rays only.

X. Breast with a large sucking disk between ventral fins.. .... **Gobiesocidae**

XX. Breast without sucking disk.

Y. Body covered with a coat of mail; dorsal very short... .... **Agonidae**

YY. Body not mailed; dorsal many-rayed.

Z. Lateral line and base of dorsal beset with prickles; skeleton very soft; body compressed............ **Icosteidae**

ZZ. Lateral line unarmed.

a. Tail isocercal, the vertebral column pointed behind, the last vertebrae very small; hypercoracoid not perforate; no pseudobranchiae.

b. Caudal fin wanting......................... **Macrouridae.**

aa. Tail not isocercal, truncate at base of caudal; hypercoracoid perforate.

c. Gill membranes joined to the isthmus; pseudobranchiae present.

d. Ventral fins under shoulder girdle............ **Zoarcidae.**

cc. Gill membranes free from the isthmus.

e. Ventral fins inserted below or before the eyes; pseudobranchiae generally well developed......... **Ophidiidae**

ee. Ventral fins inserted below shoulder girdle; no pseudobranchiae .... **Brotulidae**

LL. Upper jaw prolonged into a bony sword; dorsal fin long and high; size large..................... **Istiophoridae**

KK. Anal fin wanting; caudal fin distorted or directed upward; body ribbon-like.

f. Ventral fins each reduced to a long slender filament... .... **Regalecidae**

JJ. Gill openings behind the pectoral fins.

g. Gill openings below and behind pectorals; mouth large, nearly vertical.......................... **Antennariidae**

4. Ventral Fins Wholly Wanting.

A. Premaxillary and maxillary wanting or grown fast to the palatines; body greatly elongate, eel-shaped; gill openings restricted to the sides; scales minute or wanting; scapular arch not attached to the skull. Eels.

B. Gill openings not very far behind cranium; gape not inordinately distensible; gill arches 4 pairs.

C. Gill openings well developed, leading to large interbranchial slits; tongue present; opercles and branchial bones well developed; scapular arch present.

D. Scales wholly wanting; eggs (so far as known) of moderate size, much as in ordinary fishes.

E. Tip of tail with a more or less distinct fin, the dorsal and anal fins confluent around it; the tail sometimes ending in a long filament. Coloration almost always plain, brownish, blackish, or silvery, the fins often black-margined.

e. Pectoral fins wholly wanting; snout and jaws much produced, the upper longer; jaws straight; skin thin and skeleton weak; tail ending in a filiform tip; gill openings small, subinferior; teeth sharp, subequal, recurved, a long series on the vomer. Deep-sea eels, soft in body, black in color.. **Nettastomatidae (Nettasomidae)**

EE. Tip of tail without rays, projecting beyond the dorsal and anal fins (not filiform); posterior nostril on the edge of the upper lip; anterior nostril near tip of snout, usually in a small tube; tongue usually adnate to the floor of the mouth; coloration frequently variegated.. ....Ophichthyidae

CC. Gill openings small, roundish, leading to restricted interbranchial slits; tongue wanting; pectoral fins (typically) wanting; opercles feebly developed; fourth gill arch modified, strengthened, and supporting pharyngeal jaws.

F. Scapular arch obsolete or represented by cartilage; heart not far back; pectorals wanting; (skin thick; coloration often variegated)....................Muraenidae

AA. Premaxillary and maxillary present, often immovably united to rest of cranium.

G. Gill openings not united in a longitudinal slit.

H. Dorsal fin present.

I. Body not truly eel-shaped.

J. Gill openings far behind pectoral fins; mouth oblique, very large; spinous dorsal represented by fleshy tentacles ....Ceratiidae

JJ. Gill openings before pectoral fins.

K. Gill membranes broadly united to the isthmus, restricting the gill openings to the sides.

L. Snout tubular, bearing the short, toothless mouth at the end; body mailed..........................Syngnathidae

LL. Snout not tubular.

M. Breast without sucking disk.

N. Dorsal fin single, of spines or undivided rays only.

O. Jaws and vomer with coarse molar teeth. Anarhichadidae

OO. Jaws and vomer without molars.

P. Mouth not nearly vertical; dorsal spines moderate or low, some or all of them usually pungent........Blenniidae

NN. Dorsal fins 2, the anterior of spines, the posterior of soft rays; body short and deep.

Q. Spinous dorsal of 2 or 3 spines; scales rather large, rough or bony....................................Balistidae

NNN. Dorsal fin continuous, of soft rays only.

R. Body oblong or elongate, the back not elevated; dorsal and anal joined to caudal.

S. Pectoral rather narrow, the lower rays similar to the others ....Zoarcidae

SS. Pectorals very broad, the lower rays procurrent and produced at tip.............................Liparididae

RR. Body short, not elongate; dorsal and anal free from caudal.

T. Teeth in each jaw confluent into 1.

U. Body compressed, rough.......................Molidae

UU. Body not compressed, spinous..............Diodontidae

TT. Teeth in each jaw confluent into 2. Back broadly rounded ....Tetraodontidae

MM. Breast with a sucking disk; skin perfectly smooth; dorsal continuous or slightly notched.........Liparididae

KK. Gill membranes free from the isthmus.

V. Vent posterior, not at the throat.

W. Caudal fin present.

X. Upper jaw prolonged into a sword; size very large... .... **Xiphiidae**

XX. Upper jaw not prolonged into a sword.

Y. Belly with a series of bony scutes along its edge; body much compressed............................ **Clupeidae**

Z. Body ovate, much compressed.

a. Scales small, cycloid, silvery.............. **Stromateidae**

aa. Scales wanting; caudal peduncle very slender........... .... **Icosteidae**

ZZ. Body oblong or elongate, much longer than deep.

b. Gill membranes broadly united; teeth present.

c. Dorsal fin of spines only...................... **Blenniidae**

cc. Dorsal ,n single, the posterior half of soft rays, the anterior of spines; body elongate, covered with small scales .... **Blenniidae**

ccc. Dorsal fins 2, the anterior of slender spines, posterior soft, body naked................................. **Cottidae**

bb. Gill membranes separate.

d. Jaws with teeth. Body naked, without folds of skin; no pseudobranchiae..................... **Lycodapodidae**

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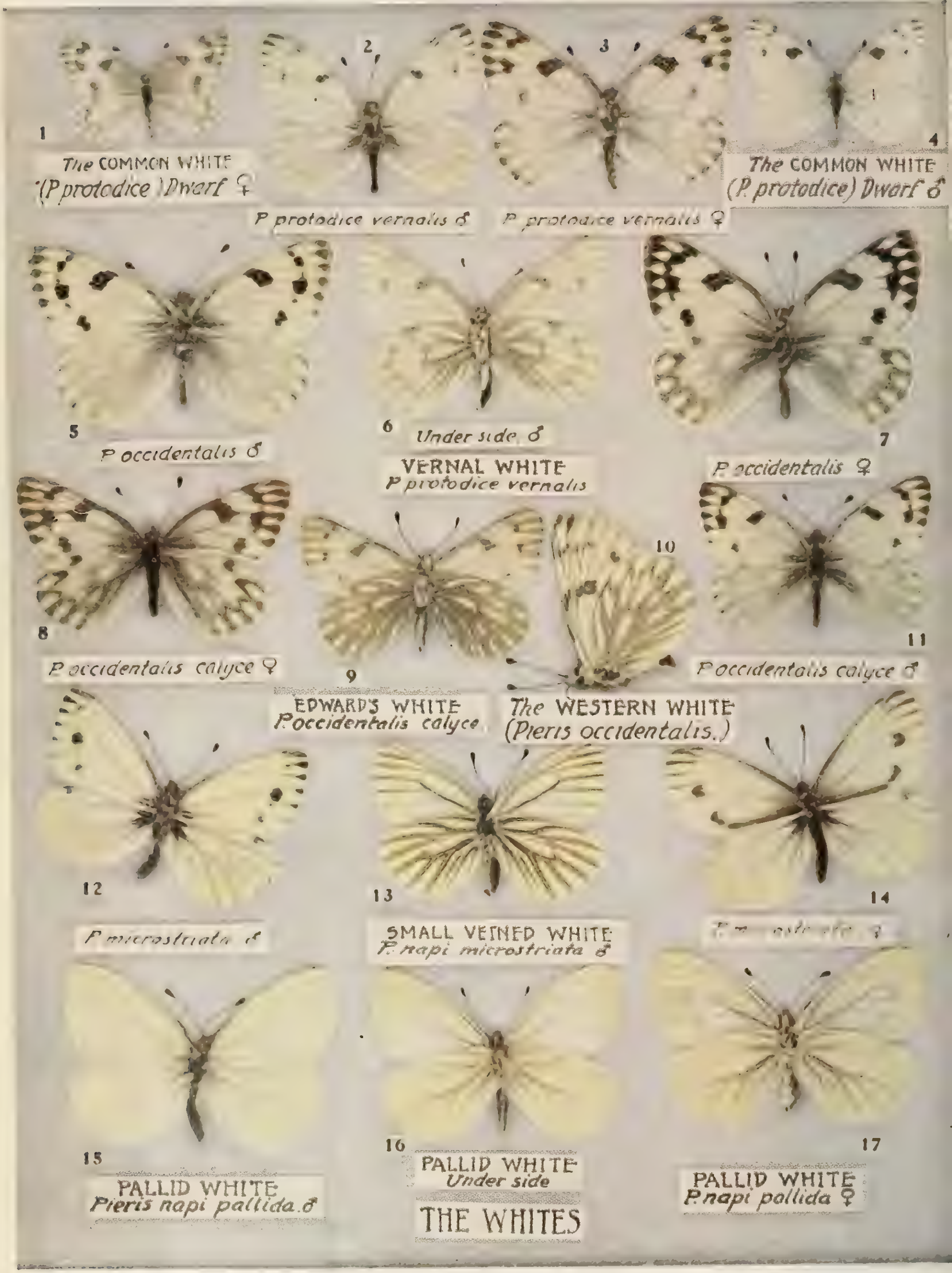

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QUATERNARY AND RECENT MOLLUSCAN FAUNAS OF THE WEST COAST OF LOWER CALIFORNIA

BY ERIC KNIGHT JORDAN
(Of Stanford University)

INTRODUCTION

The Quaternary and Recent life of the West Coast of North America offers peculiar advantages for the study of climatic and faunal relations. Not only is the representation of species very large in each horizon, but the division into distinct faunas, mainly dependent upon conditions of temperature, is pronounced and sharp. The relations between the Recent and Quaternary of Upper California have been made well known through the works of Ralph Arnold, James Perrin Smith, William Healey Dall, and many others. Smith* has recently published a general summary of the subject. To lower California, however, no such intensive study has been given. Smith, in the above cited paper, included a brief discussion of Lower Calfiornian faunas, and listed a few species from one of the Quaternary localities here discussed. Papers by Carpenter, Dall, Stearns, Bartsch, and others, contain descriptions of living shells taken here and there along the coast, and Dall** has recently recorded species from the Quaternary at Magdalena Bay and San Quentin Bay. Yet our present knowledge of the recent and extinct life of the west coast of the peninsula is not at all comparable to that of the region farther North, although the problems in Lower California are of no less interest and significance. Furthermore, when our acquaintance with the West American Recent, Quaternary and Tertiary is complete, we shall probably discover them to offer one of the finest laboratories existing for the study of the development of species and of their adaptations to changing environment, and, again, the principles of highly refined correlation here developed will hold for Cenozoic stratigraphic work in any region.

The present paper is intended as a contribution toward the general end; it comprises notes on three marine deposits of Quaternary age on the west coast of Lower California, including an attempt at correlation with the already defined horizons of Upper California, also a list, based upon the Henry Hemphill and other collections now at Stanford University, of extensions in range,

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*Climatic Relations of the Tertiary and Quaternary Faunas of the Californian Region. Proc. Calif. Acad. Sci., 4th Series, Vol. IX, 1919, pp. 123-173.

**Magdalena Bay, Nautilus, Vol. XXXII, 1918, pp. 23-26.
San Quentin Bay, West American Scientists, Vol. XIX, 1921, pp. 17-23.

previously unreported, of numerous Lower Californian Mollusks. It is to be hoped that we shall soon know the entire living fauna of Lower California, with the full distribution of all of the species, for it is only through such accurate knowledge that the relations between the recent and fossil faunas become clear. As yet, however, much remains to be done in the way of extensive and careful collecting.

I make grateful acknowledgment of the help given by Dr. James Perrin Smith, who first interested me in this study, also to Mrs. Ida Shephard Oldroyd, for frequent aid in the determination of species, and for continued assistance in other ways. Finally, I am indebted to Dr. William Healey Dall and Dr. Paul Bartsch, who have very kindly determined a number of difficult species, as later indicated.

The marine life of the west coast of North America may be divided into several distinct faunas, each consisting of an assemblage of species of which a large number are confined to a certain definite region. It is true that there are many forms not so confined, some even ranging from the tropics northward into the cool temperate zone. But each fauna as a whole reveals a decidedly characteristic aspect, and many of the component species exist successfully only under the climatic conditions prevailing in the particular faunal zone. Species so limited thus become diagnostic. In any assemblage of species, the presence of many such, even with the inevitably large number of forms of unconfined range, indicates the fauna and faunal zone, and consequently, the climatic conditions under which the assemblage lived.

Two distinct faunas exist on the west coast of Lower California. The Southern Californian now ranges southward from Point Conception to Cedros Island in Lower California. It probably extends a little farther around the great bend at Cedros, and reaches perhaps to San Hipolito Point. Beyond this general limit the characteristic species are rapidly eliminated. The fauna of the Gulf of California ranges to the north on the west coast of the peninsula approximately to Scammon's Lagoon, which is a little farther up than Cedros Island. Thus, north of Scammon's Lagoon we find living only the species of the Southern Californian fauna; between Scammon's Lagoon and the neighborhood of San Hipolito Point there is an overlapping of the Southern Californian and the Gulf faunas, both probably existing almost complete, and in about equal numbers, together, on Cedros Island. South of San Hipolito Point, or, at most, south of San Ignacio Lagoon, we find living under present climatic conditions only the warmer-water types of the Gulf of California, with none of the characteristic northern species of the Southern Californian fauna. Species of unconfined range, of course, are to be considered common to both faunas, and characteristic of neither.

Arnold* has recognized two distinct horizons in the Quaternary of Southern California. The Lower San Pedro series carries a cool water fauna marked particularly by *Pecten islandicus* Mull., *Pecten caurinus* Gld., *Venericardia barbarensis* Stearns, *Cardium corbis* Mart., *Saxidomus giganteus* Desh., *Trophon multicostata* Esch., *Natica clausa* Brod. and Sby., and other northern species. There are very few truly southern types in the assemblage. Thus the climate of the Lower San Pedro was distinctly less warm than the present, and a southward displacement of the isotherms brought a northern fauna down into the San Pedro region, where, however, it now no longer exists. Above, and in general unconformity with the Lower San Pedro, lie the Upper San Pedro beds. In these the distinctly northern forms of the older horizon are practically absent, and the fauna closely resembles that now living in Southern California, though with a small but evident influx of warmer water types from the Gulf. *Pecten subnodosus* Sby., *Pecten dentatus* Sby., *Cardium procerum* Sby., *Chione gnidia* Sby., *Dosinia ponderosa* Gray, *Eupleura muriciformis* Brod., *Mellita longifissa* Mich., etc., are characteristic species. It accordingly becomes evident that the Upper San Pedro was a warm time, a little more tropical than the present.

In the Southern Californian Quaternary, therefore, we find beds of two distinct horizons, deposited under quite different climatic conditions, as indicated by comparison of the fossil faunas with the recent. Further, we may reasonably expect that along the Lower Californian coast to the South of San Pedro, there existed in Quaternary time similar conditions of deposition and of climatic change, and we may well look there for two distinct quaternary horizons, one with a fauna of cooler-water aspect than that of the region at present, the other similar to the living fauna, or perhaps of a slightly more tropical character. These differences should become less sharp as one goes south, for faunal zones are broad and ill-defined in the tropics, but the displacement should be more or less apparent for a considerable distance beyond San Pedro.

LOWER QUATERNARY OF MAGDALENA BAY

At Stanford University we have collections made by E. Call Brown and Richard C. McGregor from the Quaternary at Magdalena Bay. Unfortunately, no notes accompany the collections, and no locality more definite than "Magdalena Bay," is given. It is sure, however, that most of the material came from the same place, and quite probable that it is all out of the same horizon, although of the latter fact one cannot be entirely certain. The general conclusions as to the relations of the fauna would, nevertheless, not be greatly altered by the presence in the list of a few forms not properly belonging with the others.

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*The Paleontology and Stratigraphy of the Marine Pliocene and Pleistocene of San Pedro, California. Mem. Calif. Acad. Sci., Vol. III, 1903.

I give below a list of the species obtained, accompanied by the living range of each as far as it is known. These ranges are important to the extent that they locate the species in one fauna or the other, or indicate a position common to both. They should, however, not be taken to be of greater significance, for they are undoubtedly incomplete. Those species belonging only to one or the other fauna are designated by a letter after the name. N (northward) shows that they are characteristic of the Southern Californian fauna; S., that they belong only to the Gulf fauna. Others apparently non-diagnostic are unmarked. Species determined by Dr. Dall are indicated by the asterisk (*); the imperfect specimen of *Bittium larum* was doubtfully named by Dr. Bartsch.

List of Species from the Lower Quaternary at Magdalena Bay

ECHINODERMATA

SPECIES	LIVING RANGE
Encope grandis Agassiz S	Magdalena Bay, to Gulf of California.
Encope micropora Agassiz S	Magdalena Bay, to Gulf of California.

PELECYPODA

SPECIES	LIVING RANGE
Leda taphria Dall N	Bodega Bay, California to Lower California.
Leda penderi Dall N	Queen Charlotte Islands, B. C. to Santa Barbara Islands.
Leda* sp. aff. callimene Dall (young)	
Arca* solida Broderip and Sowerby	San Pedro, to Paita, Peru.
Arca tuberculosa Sowerby S	Ballenas Lagoon, L. Cal., to Peru.
Ostrea palmula Carpenter	San Diego to Gulf.
Pecten subnodosus Sowerby S	Scammon's Lagoon, L. Cal. to Guayaquil, Ecuador.
Pecten latiauritus Conrad N	Monterey to L. Cal.
Pecten circularis Sowerby	Monterey to Paita.
Hinnites giganteus Gray N	Aleutian Islands to Magdalena Bay.
Pododesmus macroschismus Deshayes N	Alaska to L. Cal.
Septifer bifurcatus (Conrad) Reeve	Crescent City, Calif. to Gulf.
Modiolus fornicatus Carpenter N	Trinidad, Cal., to Cortez Bank, off San Diego.
Cardita subquadrata Carpenter N	Queen Charlotte Islands to Pt. Santo Tomas, L. Cal.
Chama pellucida Sowerby	Oregon to Chile.
Diplodonta orbella Gould	Alaska to Gulf.
Diplodonta sericata Reeve	Santa Catalina Island to Panama.
Phacoides *cancellaris Philippi S	Cedros Island, to Panama.
Phacoides *lamprus Dall S	Gulf of Cal.
Phacoides approximatus Dall	Monterey to Panama.
Phacoides nuttallii Carpenter	Santa Barbara to Mazatlan.
Phacoides *mazatlanicus Carpenter	Mazatlan.
Phacoides richthofeni Gabb	San Pedro to Cape San Lucas.
Divaricella perparvula Dall S	Cape San Lucas to Ecuador.
Kellia laperousii Deshayes N	Bering Sea to Pt. Santo Tomas, L. Cal.
Cardium substriatum Conrad	Santa Catalina Island to Acapulco.
Cardium consors Sowerby S	Gulf to Guayaquil.
Cardium procerum Sowerby S	Scammon's Lagoon, L. Cal. to Peru.
Cardium biangulatum Sowerby	San Pedro to Guayaquil.
Cardium elatum Sowerby	San Pedro to Panama.
Cardium graniferum Sowerby S	Gulf to Guayaquil.
Tivela stultorum Mawe N	Halfmoon Bay, Cal. to Socorro Island, off West Coast of Mexico.
Macrocallista squalida Sowerby S	Scammon's Lagoon to Peru.
Macrocallista aurantiaca Sowerby S	Gulf to Guayaquil.
Saxidomus nuttallii Conrad N	Humboldt Bay to San Diego.
Chione fluctifragra Sowerby	San Pedro to Gulf.
Chione mariae Orbigny S	Gulf to Guayaquil.
Chione undatella Sowerby	San Pedro to Guayaquil.
Chione succincta Valenciennes	San Pedro to Panama.
Paphia staminea Conrad N	Alaska to Soccorro Island.
Paphia grata Say S	Turtle Bay, L. Cal. to Antofagasta, Chile.

SPECIES	LIVING RANGE
Tellina bodegensis Hinds	Queen Charlotte Islands to Gulf.
Tellina carpenteri Dall	Forrester Island, Alaska to Gulf.
Tellina rubescens Hanley S	Scammon's Lagoon to Tumbes, Peru.
Metis alta Conrad N	Santa Barbara to San Diego.
Macoma nausta Conrad N	Alaska to Scammon's Lagoon.
Macoma secta Conrad	Vancouver, B. C. to Gulf.
Semele rubropicta Dall N	Forrester Island to Tia Juana, L. Calif.
Donax punctatostriata Hanley	San Pedro to Paita.
Donax conradi Deshayes	San Pedro to Central America.
Tagelus californianus Conrad	Santa Barbara to Gulf of Techuantepec.
Solen sicarius Gould N	Vancouver Island to San Quentin Bay, L. Cal.
Mulinia *coloradoensis Dall	
Cryptomya californica Conrad	Alaska to Topolobampo, Mexico.
Corbula porcella Dall	Santa Rosa Island to Panama.

SCAPHOPODA

Dentalium neohexagonum Sharp and Pilsbry	Monterey to Guacomayo, Central America.

GASTROPODA

*Acteocina culcitella Gould N	Alaska to Manuel's Lagoon, L. Cal.
Terebra larvaeformis Hinds S	Gulf to Panama.
Tereba robusta Hinds S	Gulf to Panama.
Terebra specillata Hinds	San Pedro to San Blas, Mexico.
Terebra variegata Gray S	Scammon's Lagoon to Galapagos Islands.
Conus *puncticulatus Hwass S	Gulf to Costa Rica.
Conus *tornatus Broderip S	Cedros Island to Ecuador
Conus *interruptus Broderip S	Magdalena Bay to Panama
Conus californicus Hinds N	Farallones Islands, Calif. to Ballenas Lagoon, L. Cal.
Conus purpurascens Broderip S	Magdalena Bay to Paita
Turricula *burragei Bartsch	
Cryptoconus carpenterianus Gabb N	Bodega Bay to San Pedro
Clathrodrillia ophioderma Dall N	Bolinas Bay to Ballenas Lagoon, L. Cal.
Oliva angulata Linnaeus S	Magdalena Bay to Peru
Olivella biplicata Sowerby	Vancouver Island to Central America.
Olivella dama Mawe S	Gulf
Olivella porteri Dall	Redondo, Calif. to Magdalena Bay.
Kellettia kellettii Forbes N	Santa Barbara to San Quentin Bay
Macron aethiops Reeve	San Quentin Bay to Gulf
Solenosteira pallida Broderip and Sowerby S	San Ignacio Lagoon to Panama
Cantharus elegans Gray S	Pt. Abreojos to Peru
Alectrion mendica Gould N	Alaska to Magdalena Bay
Alectrion cerritensis Arnold	Long Beach to Gulf
Alectrion tegula Reeve	San Francisco to Mazatlan
Alectrion perpinguis Hinds N	Puget Sound to Cedros Island
Alectrion fossata Gould N	Puget Sound to San Ignacio Lagoon
Alectrion californiana Conrad N	Coast of Oregon to Magdalena Bay
Columbella strombiformis Lamarack S	Cape San Lazaro, L. Cal. to Paita
Columbella carinata Hinds	San Francisco Bay to Cape San Lucas
Nitidella ocellata Gmelin S	Magdalena Bay to Guayaquil
Triremis festiva Hinds N	Santa Barbara to San Ignacio Lagoon
Thais biserialis Blainville	La Jolla to Peru
Acanthina lugubris Sowerby	San Diego to Galapagos Islands
Bursa californica Hinds N	Monterey to Cedros Island
Ficus decussatus Wood S	Gulf to Ecuador
Strombus gracilior Gray S	Gulf to Manta Ecuador
Strombus granulatus Gray S	Gulf to Guayaquil
Cerithium gemmatum Hinds S	Gulf to Panama
Cerithium ocellatum Bruguiere S	Magdalena Bay to Galapagos Islands
Cerithium adustum Kiener S	Magdalena Bay to Galapagos Islands
Bittium larum (?) Bartsch N	San Pedro to San Bartolome Bay, L. Cal.
Cerithidea californica Haldeman N	Bolinas Bay to San Ignacio Lagoon
Cerithidea montagnei Orbigny S	San Ignacio Lagoon to Chile
Turritella goniostoma Valenciennes S	Scammon's Lagoon to Peru
Turritella cooperi Carpenter, N	Monterey to San Diego
Hipponix tumens Carpenter N	Crescent City to San Diego
Crepidula *lingulata Gould	Bering Sea to Panama
Crepidula onyx Sowerby	Monterey to Panama
Crucibulum spinosum Sowerby	Trinidad to Chile
Crucibulum imbricatum Sowerby	La Jolla to Peru

SPECIES	LIVING RANGE
Polinices lewisii Gould N	British Columbia to San Pedro
Polinices recluziana Deshayes	Crescent City to Tres Marias Islands
Lottia gigantea Gray N	Crescent City to Cedros Island
Turbo fluctuosus Wood S	Cedros Island to Peru
Astraea undosa Wood N	Laguna Beach, Cal. to Cedros Island
Norrisia norrisii Sowerby N	Monterey to Cedros Island, L. Cal.
Tegula aureotincta Forbes	Santa Barbara Island to Magdalena Bay, L. Cal.
Tegula ligulata Menke	Monterey to Acapulco
Calliostoma gloriosum Dall N	San Francisco to San Diego
Calliostoma *eximium Reeve	Santa Catalina Island to Mazatlan
Calliostoma tricolor Gabb N	Santa Cruz, Cal. to Magdalena Bay
Megathura crenulata Sowerby N	Monterey to Cedros Island
Lucapinella callomarginata (Carpenter) Dall N	Bodega Bay to Magdalena Bay
Ischnochiton conspicuus Carpenter	Monterey to Gulf

Resumé

Pelecypoda	57
Scaphopoda	1
Gastropoda	66
Total Species	124
Species characteristic of Gulf of California Fauna	37
Species characteristic of Southern California Fauna	38
Species not characteristic of either Fauna	49

The above resumé clearly shows the character of the assemblage. Excluding those forms of wide range not particularly characteristic of any fauna, the others are about equally divided between species characteristic of the Gulf fauna and those of the Southern Californian. This condition prevails at present about Cedros Island, where the two faunas overlap, with large representation of each. It is not the condition now prevalent in the latitude of Magdalena Bay, for, as previously stated, practically all of the characteristic cooler water types are eliminated some distance north of the Bay and the Gulf fauna alone exists there.

It thus appears that when these quaternary beds were laid down there was a southward displacement of the isotherms sufficient to carry the conditions today prevailing at Cedros down as far as the latitude of Magdalena Bay. This was not a large displacement, and it would be most surprising to find any such violent changes in temperature here, approaching the tropics, as occurred in the San Pedro region, but the indication of a somewhat cooler period is certainly strong. Again, if we assume the displacement, the beds at Magdalena should be correlated in a general way with the Lower San Pedro Series of Upper California, which belonged to the cool time of the Quaternary. Not, of course, that these deposits are to be put into the San Pedro series proper, for here, far to the south, we have a fauna quite different from that of the Lower San Pedro, but an equivalence in time is certainly indicated.

Out of the foregoing list the following species may be selected as most suggestive of the cooler conditions: **Leda taphria** Dall, **Modiolus fornicatus** Cpr., **Saxidomus nuttallii** Conr., **Paphia staminea** Conr., **Solen sicarius** Gld., **Cryptoconus carpenterianus** Gabb, **Kellettia kelletii** Forbes, and **Polinices lewisii** Gld.

UPPER QUATERNARY OF MAGDALENA BAY

The Quaternary fossils reported from Magdalena Bay by Dall were collected on Magdalena Island. Sixty-five species, in all, were recognized by him—not a great number but surely enough to indicate in a general way the character of the fauna. Dall concludes that "on the whole the assembly has a more tropical aspect than that of the recent fauna." It is at least certain that these species lived under conditions no cooler than those now obtaining at Magdalena, and the assemblage appears quite different from that collected by

Brown and McGregor. Dall's list contains only two or three species characteristic of the Southern Californian fauna; the remainder are all either of wide distribution, or are distinctly Gulf of Californian, of which latter type the percentage is very large. It therefore seems that the beds in question should be correlated with the warm Upper San Pedro, or Upper Quaternary,—again not as the same formation, but as one of similar age.

It is hoped that with farther field work the presence of two distinct Quaternary formations in the Magdalena Bay region may be verified. More extensive collecting, with coincident study of the geologic relations would settle the question. There is always an element of doubt entering into conclusions such as these when the field conditions are imperfectly known.

UPPER QUATERNARY OF SAN IGNACIO LAGOON

A small collection was made by C. R. Swarts and T. J. Cullen from Quaternary deposits near San Ignacio Lagoon. According to a note accompanying the material, it came from a raised beach some five to seven miles inland. The following are recognized:

PELECYPODA

SPECIES	LIVING RANGE
Glycimeris giganteus Reeve S	Gulf of Cal. to Peru
Ostrea palmula Carpenter	San Diego to Gulf.
Pecten circularis Sowerby	Monterey to Paita.
Phacoides nuttallii Conrad	Santa Barbara to Mazatlan.
Cardium procerum Sowerby S	Scammon's Lagoon to Peru.
Cardium substriatum Conrad	Santa Catalina Island to Acapulco
Chione succincta Valenciennes	San Pedro to Panama.
Chione gnidia Broderip and Sowerby S	Cedros Island to Paita.
Tellina modesta Carpenter N	Vancouver Island to L. Cal.
Tellina reclusa Dall S	San Ignacio Lagoon, L. Cal. to Gulf.
Macoma inquinata Deshayes N	Alaska to San Pedro.
Macoma yoldiformis Carpenter N	Puget Sound to San Diego.
Anatina undulata Gould	San Pedro to Panama.
Mactra californica Conrad N	Coast of Washington to Manuel's Lagoon, L. Cal.
Corbula luteola Carpenter	Monterey to Acapulco.

SCAPHOPODA

Dentalium pretiosum Sowerby N	Forrester Island, Alaska to San Diego.

GASTROPODA

*Turricula burragei Bartsch S	Gulf.
Olivella pedroana Conrad	Puget Sound to Cape San Lucas.
Olivella dama Mawe S	Gulf.
Olivella inconspicua C. B. Adams S	Gulf to Panama.
Oliva angulata Linnaeus S	Magdalena Bay to Peru.
Oliva spicata Bolten S	San Ignacio Lagoon to Peru.
Fusinus dupetithouarsii Kiener S	La Paz, L. Cal. to Galapagos Islands.
Nitidella ocellata, Gmelin S	Magdalena Bay to Guayaquil.
Phyllonotus bicolor Valenciennes S	Guaymas to Paita.
Phyllonotus radix Lamarck S	Scammon's Lagoon to Paita.
Eupleura muriciformis Broderip S	Gulf to Colombia.
Strombus graoilior Sowerby S	Gulf of Cal. to Manta, Ecuador.
Cerithium ocellatum Sowerby S	Magdalena Bay to Galapagos Islands.
Cerithidea californica Haldeman N	Bolinas Bay to Scammon's Lagoon.
Polinices recluziana Deshayes	Crescent City to Tres Marias Islands.
Calliostoma tricolor Gabb	Santa Cruz to Magdalena Bay.

Resumé

Pelecypoda	15
Scaphopoda	1
Gastropoda	16
Total species	32
Species Characteristic of Gulf of Californian Fauna	16
Species Characteristic of Southern Californian Fauna	6
Species not Characteristic of either Fauna	10

The above list is rather short to serve as a basis for any definite conclusions. San Ignacio Lagoon lies north of Magdalena Bay, and is at present about the southern limit of the Southern Californian faunal zone. Taking the list for what it may be worth, however, the assemblage appears very like what would be expected in the Recent fauna of the Lagoon. There is no excess of northern species over those now living in the region, and there is little doubt that the beds are younger than the cold Lower Quaternary. Lacking fuller knowledge of the fauna, the correlation seems to be with the upper beds of Magdalena Island.

UPPER QUATERNARY OF SCAMMON'S LAGOON

In 1921, B. F. Hake collected the following Quaternary fossils from raised beaches near Scammon's Lagoon:

PELECYPODA

SPECIES	LIVING RANGE
Arca pacifica Sowerby S	Scammon's Lagoon to Paita.
Pecten circularis Sowerby	Monterey to Paita.
Phacoides nuttallii Conrad	Santa Barbara to Mazatlan, Mexico.
Cardium procerum Sowerby S	Scammon's Lagoon to Peru.
Macrocallista squalida Sowerby S	Scammon's Lagoon to Peru.
Chione succincta Valenciennes	San Pedro to Panama.
Chione fluctifragra Sowerby	San Pedro to Gulf.
Tagelus californianus Conrad	Santa Barbara to Gulf of Tehuantepec.
Mactra californica Conrad N	Coast of Washington to Manuel's Lagoon.

GASTROPODA

Bullaria punctulata A. Adams S	Gulf to Peru.
Turricula maculosa Sowerby S	Gulf to Guayaquil.
Olivella dama Mawe S	Gulf.
Macron aethiops Reeve	San Quentin Bay to Gulf.
Columbella strombiformis Lamarck S	Cape San Lazaro, L. Cal. to Paita.
Murex recurvirostris Broderip S	Scammon's Lagoon to Ecuador.
Phyllonotus radix Gmelin S	Scammon's Lagoon to Paita.
Phyllonotus bicolor Sowerby S	Guaymas to Paita.
Cerithium ocellatum Bruguiére S	Magdalena Bay to Galapagos Islands.
Cerithidea californica Haldeman N	Bolinas Bay to San Ignacio Lagoon.
Turritella goniostoma Valenciennes S	Scammon's Lagoon, L. Cal. to Peru.
Crucibulum imbricatum Sowerby	La Jolla to Peru.
Polinices recluziana Deshayes	Crescent City to Tres Marias Islands.
Modulus cerodes A. Adams S	Gulf to Galapagos Islands.
Turbo fluctuosus Wood S	Cedros Island to Peru.

Resumé

Pelecypoda	9
Gastropoda	15
Total Species	24
Species Characteristic of Gulf of Californian Fauna	14
Species Characteristic of Southern Calfiornian Fauna	2
Species not Characteristic of either Fauna	8

This list is very short; the Gulf of Californian aspect is nevertheless most striking. With but two exceptions, indeed, the characteristic species are all of the south, yet Scammon's Lagoon is well within the present range of the Southern Californian fauna, and it is somewhere near there that the Gulf fauna is now extinguished. While no definite conclusions can be based on this small number of species, what we have would indicate conditions warmer than the present, and would provisionally correlate the deposits with the Upper San Pedro and with the beds of Magdalena Island.

EXTENSIONS IN RANGE OF LOWER CALIFORNIAN MOLLUSKS

The remainder of this paper comprises a list of ranges of some Lower Californian mollusks as extended by previously unreported localities from material at Stanford University mainly obtained from Mr. Henry Hemphill who made considerable collections at various points on the West Coast of the peninsula. While many of Hemphill's localities have been recorded in one way or another, no general

report was ever made. His material and notes more or less extend the known range of some one hundred and fifty species, as given below together with a few records based on various small lots from different sources. The other extreme of the range as far as known is given for each species. In every case the name of the collector appears with the new locality. An attempt has been made to keep in accord with the latest accepted nomenclature, though where a species is not listed in any of Dall's recent papers, this has in some cases been found difficult. Species from the Hemphill collection are marked H.

PELECYPODA

SPECIES	LIVING RANGE
Arca labiosa Sowerby	Scammon's Lagoon (H) to Tumbes, Peru.
Arca reeviana Orbigny	Manuel's Lagoon (H) to Tumbes, Peru.
Arca pacifica Sowerby	Scammon's Lagoon, L. Cal. (H) to Tumbes, Peru.
Arca reticulata Gmelin	San Pedro, Calif. (O) to Ecuador.
Pinna rugosa Sowerby	Manuel's Lagoon, L. Cal. (H) to Panama.
Melina chemnitziana Orbigny	San Ignacio Lagoon, L. Cal. (H) to Panama.
Margaritiphora sterna Gould	San Diego, Cal. *(Kelsey) Scammon's Lagoon, L. Cal. (H) to Panama.
Ostrea amara Carpenter	San Diego, Cal.*
Ostrea conchaphila Carpenter	San Diego, Calif.* (K) San Ignacio Lagoon, L. Cal. (H) to Mazatlan.
Pecten subnodosus Sowerby	Scammon's Lagoon, L. Cal. (H) to Guayaquil.
Lima pacifica Orbigny	Lower California (C) to Guayaquil.
Spondylus crassisquama Lamarck	Scammon's Lagoon, L. Cal. (H) to Guayaquil.
Modiolus modiolus Linnaeus	San Ignacio Lagoon, L. Cal. (H) to Bering Sea.
Modiolus mutabilis Carpenter	San Ignacio Lagoon, L. Cal. (H) to Ecuador.
Thracia curta Conrad	San Hipolito Pt., L. Cal. (H) to Ecuador.

*The localities of San Diego in Kelsey's collection may be open to question.

SPECIES	LIVING RANGE
Lyonsia californica Conrad	Manuel's Lagoon, L. Cal. (H) to Bering Sea.
Mytilimeria nuttallii Conrad	Round Island, L. Cal. (H) to Vancouver Island.
Crassatellites margarita Carpenter	Santa Catalina Island, Cal. (H), San Hipolito Pt., L. Cal. (H) to Mazatlan.
Cardita affinis Sowerby	Pequeña Bay, L. Cal. (H) to Panama.
Cardita subquadrata Carpenter	Pt. Santo Tomas, L. Cal. (H) to Queen Charlotte Island.
Kellia laperousii Deshayes	Pt. Santo Tomas, L. Cal. (H) to Bering Sea.
Rochefortia tumida Carpenter	Scammon's Lagoon, L. Cal. (H) to Shumargin Island, Alaska.
Serridens oblonga Carpenter	San Hipolito Pt. L. Cal. (H) to San Pedro, Calif.
Cardium procerum Sowerby	Scammon's Lagoon, L. Cal. (H) to Lobos Islands, Peru.
Cardium aspersum Sowerby	Manuel's Lagoon, L. Cal. (H) to Guayaquil.
Tivela byronensis Gray	Lagoon Heads, L. Cal., (H) to Guayaquil, Ecuador.
Tivela planulata Broderip and Sowerby	Magdalena Bay, L. Cal. (H) to Coquimbo, Chile.
Transennella tantilla Gould	San Hipolito Pt., L. Cal. (H) to Sitka.
Macrocallista squalida Sowerby	Scammon's Lagoon, L. Cal. (H) to Peru.
Cyclinella singleyi Dall	Scammon's Lagoon, L. Cal. (H) to Gulf of California.
Chione kellettii Hinds	Todos Santos Bay, L. Cal. (U. S. N. M.) to Panama.
Paphia grata Say	Turtle Bay, L. Cal., (H) to Antofagasta, Chile.
Petricola cognata C. B. Adams	Scammon's Lagoon, L. Cal. (H) to Panama.
Petricola tenuis A. Adams	San Ignacio Lagoon, L. Cal. (H) to Panama.
Petricola robusta Sowerby	Cape San Lucas, L. Cal. (C) to Guayaquil.

SPECIES	LIVING RANGE
Tellina crystallina Wood	Scammon's Lagoon, L. Cal., (H) to Guayaquil.
Tellina ochracea Carpenter	San Ignacio Lagoon (H) to Gulf of California.
Tellina rubescens Hanley	Scammon's Lagoon, L. Cal., (H) to Tumbes, Peru.
Macoma indentata Carpenter	Scammon's Lagoon, L. Cal. (H) to Puget Sound.
Semele decisa Conrad	Pt. Abreojos, L. Cal. (H) to San Pedro.
Semele flavescens Gould	San Pedro (Oldroyd) Scammon's Lagoon, L. Cal. (H) to Callao, Peru.
Semele venusta A. Adams	Scammon's Lagoon, L. Cal. (H) to West Colombia.
Mactra californica Conrad	Neah Bay, Washington to Manuel's Lagoon, L. Cal. (H).
Spisula hemphilli Dall	Todos Santos Bay, L. Cal. (H) to San Pedro.
Spisula falcata Gould	Manuel's Lagoon, L. Cal. (H) to Puget Sound.
Schizothaerus nuttallii Conrad	Scammon's Lagoon, L. Cal. (H) to Wrangel, Alaska.
Panopea generosa Gould	Scammon's Lagoon, L. Cal. (H) to Puget Sound.
Corbula luteola Carpenter	Acapulco, Mexico (Arnold) to Monterey.
Gastrochaena ovata Sowerby	Scammon's Lagoon, L. Cal. (H) to La Plata Island, Ecuador.
Barnea pacifica Stearns	Scammon's Lagoon, L. Cal. (H) San Francisco Bay.
Zirfaea gabbi Tryon	Scammon's Lagoon, L. Cal. (H) to Bering Sea.
Pholadidea penita Conrad	Pt. Abreojos, L. Cal. (H) to Alaska.

GASTROPODA

SPECIES	LIVING RANGE
Acteocina culcitella Gould	San Ignacio Lagoon, L. Cal. (H) to San Pedro.
Williamia vernalis Dall	Galapagos Islands. Manuel's Lagoon, L. Cal. (H) to
Terebra variegata Gray	Manuel's Lagoon, L. Cal. (H) to Kodiak Island, Alaska.
Terebra pedroanum Dall	City, Calif. San Hipolito Pt., L. Cal. (H) Crescent
Terebra larvaeformis Hinds	Scammon's Lagoon, L. Cal. (H) to Guayaquil .
Conus fergusoni Sowerby	Magdalena Bay, L. Cal. (H) to Galapagos Islands.
Conus scalaris Valenciennes	Scammon's Lagoon, L. Cal. (H) to Gulf of California.
Conus regularis Sowerby	Scammon's Lagoon, L. Cal. (H) to Panama.
Cymatosyrinx pudica Hinds	Scammon's Lagoon, L. Cal. (H) to Central America.
Pseudomelatoma torosa Carpenter	San Ignacio Lagoon, L. Cal. (H) to Monterey.
Pseudomelatoma moesta Carpenter	Pt. Abreojos, L. Cal. (H) to Monterey.
Philbertia sculpta Hinds	Scammon's Lagoon, L. Cal. (H) to Panama.
Mangilia hamata Carpenter	San Diego, Calif. (Gripp) Pt. Abrejos, L. Cal. (H) to Panama.
Cancellaria obesa Sowerby	Pt. Abreojos, L. Cal. (H) to Guayaquil, Ecuador.
Cancellaria goniostoma Sowerby	Pt. Abreojos, L. Cal. (H) to Central America.
Oliva spicata Bolten	Pt. Abreojos, L. Cal. (H) to Guayaquil.
Olivella anazora Duclos	Pequeña Bay, L. Cal. (H) to Xipixapi, Colombia.
Olivella volutella Lamarck	Magdalena Bay, L. Cal. (H) to Paita.
Harpa crenata Swainson	Margarita Island, L. Cal. (Johnson) to Panama.
Marginella jewettii Carpenter	San Hipolito Pt., L. Cal. (H) to Monterey.
Marginella subtrigona Carpenter	Pt. Abreojos, L. Cal. (H) to Monterey.
Cypraeolina margaritula Carpenter	San Hipolito Pt., L. Cal. (H) to Mazatlan.
Macron lividus A. Adams	Pt. Abreojos, L. Cal. (H) to Farallones Islands, Cal.
Galeodes patulus Broderip	San Ignacio Lagoon, L. Cal. (H) to Ecuador.
Solenosteira anomala Reeve	Magdalena Bay, L. Cal. (H) Ecuador (Stanley Herold) to Mazatlan.
Cantharus lugubris C. B. Adams	Scammon's Lagoon, L. Cal. (H) to Panama.

SPECIES	LIVING RANGE
Cantharus elegans Gray	Pt. Abreojos, L. Cal. (H) to Paita.
Sistrum ferrugineum Reeve	Pt. Abreojos, L. Cal. (H) to Gulf of California.
Alectrion californianum Conrad	Magdalena Bay, L. Cal. (H) to Coast of Oregon.
Alectrion fossatum Gould	San Ignacio Lagoon, L. Cal. (H) to Puget Sound.
Alectrion tegula Reeve	San Ignacio Lagoon, L. Cal. (H) to San Francisco.
Anachis coronata Sowerby	Scammon's Lagoon, L. Cal. (H) to Panama.
Anachis fuscostrigata Carpenter	San Hipolito Pt., L. Cal. (H) to Cape San Lucas.
Anachis gaskoinii Carpenter	San Hipolito Pt., L. Cal. (H) to Mazatlan.
Anachis humerosa Carpenter	San Hipolito Pt., L. Cal. (H) to Acapulco.
Anachis subturrita Carpenter	Pt. Abreojos, L. Cal. (H) to San Pedro.
Anachis tincta Carpenter	San Hipolito Pt., L. Cal. (H) to Cape San Lucas.
Anachis pulchrior C. B. Adams	San Hipolito Pt., L. Cal. (H) to Panama.
Anachis fluctuata Sowerby	San Ignacio Lagoon, L. Cal. (H) to Paita.
Columbella gausapata Gould	San Hipolito Pt., L. Cal. (H) to Port Etches, Alaska.
Columbella strombiformis Lamarck	Cape San Lazaro, L. Cal. (H) to Paita.
Aesopus hemphilli Stearns	San Diego, Cal. (H) to Pt. Abreojos, L. Cal. (H).
Nitidella gouldii Carpenter	Manuel's Lagoon, L. Cal. (H) to Kodiak Island.
Nitidella ocellata Gmelin	Magdalena Bay, L. Cal. (H) to Guayaquil.
Strombina recurva Sowerby	San Ignacio Lagoon, L. Cal. (H) to Guayaquil.
Murex recurvirostris Broderip	Scammon's Lagoon, L. Cal. (H) to Ecuador.
Murex elenensis Dall	Scammon's Lagoon, L. Cal. (H) to Guayaquil.
Murex trialatus Sowerby	San Ignacio Lagoon, L. Cal. (H) to Bodega Bay, Calif.
Murex leeanus Dall	Scammon's Lagoon, L. Cal. (H) to Cedros Island.
Triremis gemma Dall	San Hipolito Pt., L. Cal. (H) to Santa Barbara.
Triremis festiva Hinds	San Ignacio Lagoon, L. Cal. (H) to Santa Barbara.
Phyllonotus radix Lamarck	Scammon's Lagoon, L. Cal. (H) to Paita.
Tritonalia hamata Hinds	San Ignacio Lagoon, L. Cal. (H) to Paita.
Tritonalia interfossa Carpenter	Pt. Santo Tomas, L. Cal. (H) to Semidi Islands, Alaska.
Purpura nuttallii Conrad	San Ignacio Lagoon, L. Cal. (H) to Monterey.
Thais patula Linnaeus	Pt. Abreojos, L. Cal. (H) to Galapagos Islands.
Thais triangularis Blainville	Margarita Island, L. Cal. (H) to Paita.
Acanthina lugubris Sowerby	San Diego, Calif. (Ritchie) Todos Santos Bay, L. Cal. (H) to Galapagos Islands.
Epitonium acapulcanum Dall	Pt. Abreojos, L. Cal. (H) to Acapulco.
Epitonium propehexagonum Dall	San Hipolito Pt., L. Cal. (H) to Mazatlan.
Melanella abreojosensis Bartsch	San Hipolito Pt., L. Cal. (H) to Pt. Abreojos, L. Cal. (H).
Melanella baldra Bartsch	Pt. Abreojos, L. Cal. (H) to San Hipolito Pt., L. Cal.
Turbonilla castanea Keep	San Hipolito Pt., L. Cal. (H) to San Pedro.
Turbonilla paramoea Dall and Bartsch	San Ignacio Lagoon, L. Cal. (H) to Panama.
Turbonilla cora Orbigny	San Hipolito Pt., L. Cal. (H) to Paita.
Turbonilla panamensis C. B. Adams	Round Island, L. Cal. (H) to Panama.
Odostomia astricta Dall and Bartsch	San Hipolito Pt., L. Cal. (H) to Monterey.
Odostomia grammatospira Dall and Bartsch	San Hipolito Pt., L. Cal. (H) to Cape San Lucas.
Odostomia navisa Dall and Bartsch	Pt. Abreojos, L. Cal. (H) to San Pedro.

SPECIES	LIVING RANGE
Odostomia aequisculpta Carpenter	San Diego, Calif. (H) to Cape San Lucas
Odostomia communis C. B. Adams	Pt. Abreojos, L. Cal. (H) to Panama
Odostomia inflata Carpenter	Monterey, Cal. (H) San Hipolito Pt., L. Cal. (H) to Neah Bay, Wash.
Cymatium wiegmanni Anton	San Ignacio Lagoon, L. Cal. (H) to Paita
Cypraea annettae Dall	Pt. Abreojos, L. Cal. (H) to Sechura Bay, Peru.
Cypraea arabicula Lamarck	San Hipolito Pt., L. Cal. (H) to Paita.
Erato vitellina Hinds	Pt. Santo Tomas, L. Cal. (H) to Bodega Bay.
Malea ringens Swainson	San Ignacio Lagoon, L. Cal. (H) to Paita.
Cyphoma emarginata Sowerby	Magdalena Bay, L. Cal. (H) to Guayaquil.
Cerithiopsis antefilosa Bartsch	San Hipolito Pt., L. Cal. (H) to San Pedro.
Cerithiopsis berryi Bartsch	Pt. Abreojos, L. Cal. (H) to Monterey, California.
Cerithiopsis gloriosa Bartsch	Pt. Abreojos, L. Cal. (H) to San Diego.
Cerithiopsis neglecta C. B. Adams	Pt. Abreojos, L. Cal. (H) to Panama.
Cerithiopsis pupiformis Carpenter	Pt. Abreojos, L. Cal. (H) to Mazatlan.
Metaxia diadema Bartsch	Pt. Abreojos, L. Cal. (H) to Monterey.
Cerithium adustum Kiener	Magdalena Bay, L. Cal. (H) to Galapagos Islands.
Cerithium interruptum Menke	Pt. Abreojos, L. Cal. (H) to Manta, Ecuador.
Cerithium ocellatum Bruguiére	Magdalena Bay, L. Cal. (H) to Galapagos Islands.
Alabina diomedeae Bartsch	Scammon's Lagoon, L. Cal. (H) to Gulf of Cal.
Bittium asperum Gabb	Ballenas Bay, L. Cal. (H) to Santa Catalina Island.
Bittium rugatum Carpenter	Santa Barbara, Cal. to Todos Santos Bay, L. Cal. (H).
Bittium interfossa Carpenter	Todos Santos Bay, L. Cal. (H) to Monterey.
Cerithidea californica Haldeman	San Ignacio Lagoon, L. Cal. (H) to Bolinas Bay.
Cerithidea montagnei Orbigny	San Ignacio Lagoon, L. Cal. (H) to Chile.
Vermiculum anellum Mörch	San Hipolito Point, L. Cal. (H) to Monterey.
Turritella goniostoma Valenciennes	Scammon's Lagoon, L. Cal. (H) to Lobos Islands, Peru.
Turritellopsis stimpsoni Dall	San Ignacio Lagoon, L. Cal. (H) to Nunivak Island, Alaska.
Littorina cognata Hemphill	Manuel s Lagoon, L. Cal. (H) to San Hipolito Pt. (H).
Littorina varia Sowerby	Magdalena Bay, L. Cal. (H) to Casma, Peru.
Littorina aspera Philippi	San Hipolito Pt., L. Cal. (H) to Panama.
Modulus disculus Philippi	Magdalena Bay, L. Cal. (H) to Acapulco.
Diala acuta Carpenter	San Hipolito Pt., L. Cal. (H) to Monterey.
Cingula kelseyi Dall	Pt. Abreojos, L. Cal. (H) to San Diego.
Rissoina firmata C. B. Adams	San Hipolito Pt. L. Cal. (H) to Panama.
Natica unifasciata Lamarck	San Ignacio Lagoon, L. Cal. (H) to Panama
Polinices uber Valenciennes	San Ignacio Lagoon, L. Cal. (H) to Callao, Peru.
Acmaea depicta Hinds	San Hipolito Pt., L. Cal. (H) to Santa Barbara.
Nerita scabricostata Lamarck	San Ignacio Lagoon, L. Cal. (H) to Ecuador.
Neritina picta Sowerby	Soledad, L. Cal. (H) to Panama.
Margarites parcipicta Carpenter	Todos Santos Bay, L. Cal. (H) to Sitka, Alaska.
Calliostoma supragranosum Carpenter.	Pequeña Bay, L. Cal. (H) to San Pedro.
Calliostoma tricolor Gabb.	Magdalena Bay, L. Cal. (H) to Santa Cruz.
Cyclostremella californica Dall and Bartsch	Pt. Abreojos, L. Cal. (H) to San Pedro.
Ischnochiton corrugatus Carpenter	Magdalena Bay, L. Cal. (H) to Santa Catalina.

BUTTERFLIES OF CALIFORNIA—Continued

By

JOHN ADAMS COMSTOCK, M. A., M. D., F. E. S.

GENUS PIERIS.

Cabbage Butterfly (Pieris rapae, L.) This is one of the most serious pests of North America. It feeds upon members of the cabbage family, with a resulant loss of millions of dollars to the truck gardeners of the United States. Like many other pests it is polygoneutic, or in other words produces many generations in a season. The mild climate of California allows it to propagate throughout practically the entire year.

Rapae is not a native of the Americas, but like the English sparrow, is an undesirable migrant from the old world. It was first reported in Quebec about 1860, and rapidly spread over the entire continent.

An aberrant yellow form of this species occurs in the north eastern portion of North America, which is sufficiently distinct to have been given the name of **novangliae Scud, (The Tinted Cabbage White)**. It has not, thus far, been recorded from our state, but the boreal environment of our uplands may not unlikely produce it in time, and it is, therefore, pictured in plate IX, figure 14. The normal form is shown in figures 13 and 15 of the same plate. This will be subsequently published in the "Bulletin."

Color plate VIII shown in this issue is illustrative of the text published in the "Bulletins" for March-April 1924, and July-August 1924.

A NEW RECORD FOR CALIFORNIA

The writer has received from Dr. Frank Clark of Santa Monica a specimen of Papilio polydamas, Linn. which was taken in the Miramar Hotel gardens on September 16th of this year. This Papilio has not previously been recorded for California. It's normal habitat is the West Indies, Mexico, Central and parts of South America. The only points in the United States from which it has heretofore been recorded are Florida and Texas, where it is by no means common.

It is possible that this specimen was introduced as a chrysalis on some exotic plant and that it will remain an isolated record. On the other hand it may have come north from Mexico and may now have a foothold in the States. If so we may consider that the environment is not conducive to its permanent establishment since the normal food plant of this particular group of Papilios is **Aristolochia.** So far as we know this Genus of plants is not native to southern California although a few of the vines may have been used here, as in the east, for trellis and porch-shading purposes.

Another Papilio which feeds on the same genus of plants is P. philenor. This Papilio has frequently been recorded for southern California and may have adopted some new food plant. The Mexican immigrant therefore, may be able to change its feeding habits in the same manner.

Our lepidopterists are asked to be on the lookout for this southern visitor, and to send their records to the Southwest Museum. In this manner we may be able to determine whether or not it has become established in the state.

JOHN A. COMSTOCK.

A NEW NOCTUID MOTH FROM ARIZONA

By CHAS. A. HILL, Glendale, Calif.

Chamoclea benjamini, sp. nov.

Antennae finely ciliated, red-brown; head deep purple brown; collar and patagium rich orange; shaded to creamy white on thorax; abdomen orange-brown. Primaries—basal area rich orange brown. T. A. line narrow scallop and cream white. T. P. line sharply defined by the creamy white area extending to outer margin and fringe. Reniform defined by a white line interiorly, the center having a slight mixture of blue scales, this blue scaling continuing intermittently along costal margin centrally. Median area rich purple brown, terminating along vein III, being orange-brown from vein III to inner margin. Secondaries, uniformly smoky brown; fringes white.

Beneath shiny smoky, secondaries rather paler with fringes whitish. Expanse 22 to 28 mm.

Habitat: So. Arizona (August).

Types in Coll. Hill.

Described from 8 specimens, 5 ♂, 3 ♀, ♂ holotype, ♀ allotype, 4 ♂ paratypes and 2 ♀ paratypes, paratypes marked No. 1 to 6, incl. Paratype No. 1 ♂ to be deposited in collection of Dr. Wm. Barnes.

There is no similarity between this distinct, little beauty and the other two species thus far described in the genus. A figure of this insect will appear in the next issue of this Bulletin.

The author takes pleasure in naming this gem for Dr. Foster H. Benjamin whose kind help and encouragement is greatly appreciated.

VIOLETS OF SOUTHERN CALIFORNIA

VESTA MARIE NEWSOM*

INTRODUCTION

Brainerd's recent revision of North American Violets (Vt. Agric. Exp. Sta. Bull. 224:1—172. 1921) presents a very workable treatment and would make such papers as this one quite unnecessary, were it not that so little mention is made of the occurrence of any species of Viola in our region.

In the preparation of this paper, assistance has been given by several, to whom I hereby acknowledge my indebtedness: Dr. Philip A. Munz, of Pomona College, under whose direction this study was made, and Dr. N. L. Gardner and Mr. S. B. Parish, of the University of California, and Dr. Ezra Brainerd, for supplying material and information.

All but one of the species have been studied in the field and careful notes made of color and habit. Material has also been available from the following herbaria, for which the abbreviations indicated below are used in citing specimens:

Herbarium of the University of California (C), and

Baker Herbarium of Pomona College (B).

KEY TO THE SOUTHERN CALIFORNIA SPECIES OF VIOLA†

Plant acaulescent or without manifest stems; flowers with a short saccate spur; cleistogamous flowers present.

Petals violet-purple; rootstock thickened, without stolons.......... ....1. *V. nephrophylla* Greene.
Petals white, with dark purple lines present on the 3 lower ones; rootstock slender, with stolons..........2. *V. Macloskeyi* Lloyd.

Plant caulescent, or with manifest stems; spurs on flowers various; no cleistogamous flowers present, with exception of V. adunca.
Leaves cut or lobed.

Leaves bipinnately disected; lateral petals bearded.............. ....6. *V. chrysantha* Hooker.
Leaves palmately parted or divided; bearding various.

Lateral petals bearded; leaves palmately 3-5 parted, with parts 2-5 lobed or only dentate...............8. *V. lobata* Benth.

Lateral petals not bearded; leaves palmately trisected, with segments 2-5 parted and each part irregularly 2-5 lobed or cleft. ....7. *V. Sheltonii* Torr.
Leaves not cut or lobed, but entire, with margin entire to serrate-dentate.

*Contribution of Department of Botany, Pomona College, Claremont, Calif.
†In addition to species herein given, **V. arvensis** DC. has been reported as escaped at Seven Oaks by Davidson & Moxley (Fl. So. Cal. 238. 1923).

Flowers yellow; spur not over 3 mm. long.

Leaves thin, deltoid to hastate-cordate; stems erect, 1-3 or -4 from a rootstock. Cuyamaca Mts.......8. *V. lobata* Benth.

Leaves not especially thin; leaves lanceolate to ovate or cordate; stems decumbent to ascending, but not erect, numerous.

Capsule glabrous; rootstock 1-2 cm. long, soft, pale brown; roots fascicled; plant a bright green; pubescence not retrorse; of low altitudes..............3. *V. pedunculata* T. & G.

Capsule pubescent, rootstock 3-10 cm. long, woody, dark brown; roots scattered, fibrous; pubescence at least tending to be retrorse; of altitudes above 2,000 ft.

Leaves broadly obovate to ovate, 2-3½ cm. long and 1½-3 cm. wide; margin usually dentate; found in altitudes from 2,000-7,000 ft.............4. *V. purpurea Kellogg.*

Leaves broadly lanceolate to linear-lanceolate, with a few tending to be ovate, 2-6½ cm. long and 3-12 mm. wide; margin entire to undulate; found in altitudes from 6,000-10,000 ft....5. *V. purpurea* var. *pinetorum* Greene.

Flowers blue; spur 8-10 mm. long...........9. *V. adunca* Smith.

TREATMENT OF SPECIES.

1. *Viola nephrophylla* Greene. Pitt. 3:144-5. 1896.

Acaulescent; rootstock short, thick, with many fine roots; leaves erect, round cordate to cordate-deltoid; base cordate to reniform; tip obtuse in early leaves, acute in later ones; margin crenate to crenate-serrate; younger leaves usually finely pubescent, becoming glabrous with age; blades 2-7 cm. long and 2-7 cm. wide; petioles 2-15 cm. long, glabrate; stipules small, 1-2 mm. long, ovate-lanceolate, entire or slightly toothed; cleistogamous flowers present on peduncles 2-7 cm. long, usually prostrate; flowering peduncles 7-20 cm. long, much exceeding leaves, glabrous; sepals 5-8 mm. long, ovate to lanceolate, glabrous; margin scarious; corolla 13-16 mm. long, violet, lighter near the throat, with dark veinings present; lateral petals densely bearded near base; upper petals often slightly bearded; lower petal glabrous, with a short saccate spur, 3-4 mm. long; stigma beardless; capsule ovate-oblong, glabrous, green-yellow, 8-9 mm. long.

In shaded swamps, along small streams, and about springs of the coastal area at altitudes scarcely exceeding 5,000 ft. Los Angeles Co.: Los Angeles (Davidson & Moxley, Fl. So. Cal., 238. 1923); Claremont, 1897, *Chandler* (C). San Bernardino Co.: Lytle Creek Canyon, *Street* 2770 (B), 1918, *Street* (B), *Hall* 892 (C); Mill Creek Canyon, *Smith* 4 (C), *Munz* 7578 (B); Seven Oaks (Parish, Pl. World. 20:223. 1917); Edgar Canyon, *Hall* 99 (C). Riverside Co.: Coahuilla Valley, *Hall* 1928 (C). San Diego Co.: Palomar Mt., 1921, *Snyder* (B), *Munz* 8240 (B); Cuyamaca Mt., *Munz & Harwood* 7251 (B).

Our material differs from typical *V. nephrophylla* in having the spurred petal glabrous, but it is referred to this species by Brainerd (in lit.). In literature on Southern California this species has gone by a number of names, *V. cucullata* Ait., *V. obliqua* Hill, and *V. palmata* var. *cucullata* Gray.

✓2. *Viola Macloskeyi* Lloyd. Erythea 3:74. 1895.

A small, low, acaulescent plant, forming dense patches by stolons from a slender rootstock with many, long, fine roots; leaves sub-orbicular to cordate, thin, usually broader than long; margin crenulate; tip round to obtuse; lamina slightly decurrent down petiole; lower surface of leaves glabrate to sparsely villous; blades 1-2½ cm. long and 1½-3 cm. wide; petioles 2-10 cm. long, villous-pubescent; stipules entire, ovate, acute, glabrous, 5-8 mm. long; flowering peduncles usually about twice the length of the petioles; cleistogamous peduncles one-half the length of the petioles, all sparsely villous; sepals ovate-lanceolate, distinctly 3-veined, glabrous, 4-5 mm. long; margin scarious; petals cuneate, white, the upper and lateral ones 8-10 mm. long; lateral petals bearded, sparsely dark purple veined; lower petal quite conspicuously dark purple veined, 9-11 mm. long, with a short saccate spur 2-3 mm. long; stigma not bearded; capsule ovoid to oblong, glabrous, green, 5-7 mm. long.

In boggy meadows and wet places from 7,000-9,000 ft, altitude. VENTURA Co.: Mt. Piños, *Munz* 7025 (B). SAN BERNARDINO Co.: Kelley's Cabin, San Antonio Mts., *Munz* 6082 (B; Munz, Bull. So. Cal. Acad. Sci. 22:9. 1923); Bear Valley, *Munz* 5627 (B); South Fork of Santa Ana, *Munz* 6167 (B); High Creek, San Bernardino Mts., *Crawford* (B). RIVERSIDE Co.: Round Valley, San Jacinto Mts., *Munz* 6053 (B).

The *V. blanda* Willd. of Southern California literature refers to this species.

✓3. *Viola pedunculata* Torr. & Gray. Fl. No. Am. 1:141. 1838.

Rootstock very short, thick, soft, light brown, 1-2 cm. long, with numerous fascicled, fleshy roots; stems branching, decumbent, partially subcaulescent, glabrate, tending to be purple in color, 15-35 cm. long; leaves a bright green, cordate to deltoid-ovate, often abruptly narrowed at base and decurrent down petiole, sparsely pubescent to glabrate; tip acute to obtuse; margin undulate to slightly crenate; blades 1½-4 cm. long and 1½-4¼ cm. broad; petioles somewhat pubescent, 4-12 cm. long; stipules lanceolate, 6-8 mm. long; margin entire or incised; peduncles much exceeding petioles, pubescent, 8-20 cm. long; sepals lanceolate-oblong, acute to obtuse, glabrate, 6-9 mm. long, margin scarious; petals a bright yellow, with brown-purple lines or blotches on face near throat within, and usually quite brown-purple or with brown-purple lines without, especially on the 2 upper petals and the spur; lateral petals clavate bearded; lower petal with a short saccate spur, 2 mm. long; stigma slightly bearded, capsule glabrous, yellow-brown, oblong-ovoid, 8-11 mm. long.

Common on grassy slopes and occasional in open rocky places in the chaparral. Type locality: "California." It occurs at low altitudes of the entire coastal drainage; and a citation of specimens is hardly necessary. It is on the islands in a rather pubescent form, with deeply colored flowers: Santa Cruz Is., 1924, *M. E. Jones* (B); Santa Rosa Is., (Brandegee, Zoe 1:133. 1890); Santa Catalina Is., (Brandegee, l. c.; Millspaugh & Nuttall, Field Mus. Nat. Hist. Bot. 5:174. 1923); San Clemente Is., *Munz* 6660 (B; Trask, Bull. So. Cal. Acad. Sci. 3:92. 1904).

The glabrous capsule, the exceedingly short thick rootstock, the brighter green foliage, the scarcely, if at all, retrorse pubescence, and the occurrence at lower altitudes, make this species quite distinct from V. purpurea Kellogg.

4. *Viola purpurea* Kellogg. Proc. Cal. Acad. 1:55. 1855. *V. aurea* Kellogg. Proc. Cal. Acad. 2:185. t54. 1862.

Rootstock often slender, perpendicular, dark brown, woody, 3-15 cm. long with scattered fibrous roots; plant varying from glabrate in the shade, to canescent, with a white, often dense, retrorse pubescence in exposed forms; stems clustered, low, branching, somewhat subcaulescent, ascending; leaves sub-orbicular to lance-ovate, tapering to petiole; tip broadly obtuse to acute; margin undulate to lobed-dentate; blades 2-3½ cm. long, 1½-3 cm. wide; petioles 3-5 cm. long; stipules linear-lanceolate, entire to slightly dentate at tip, 8-10 mm. long; peduncles usually exceeding leaves, 4-8 cm. long; sepals lanceolate, acute, 5-7 mm. long; margin scarious; petals pale yellow within with dark purple lines on the three lower ones, all more or less brown-purple without, 11-13 mm. long; lateral petals clavate bearded; lower petal with a short saccate spur, 1½ mm. long; stigma with a long beard at sides; capsule green, strongly pubescent, globose, 7-9 mm. long.

On dry slopes and ridges at altitudes from 2,000-7,000 ft., occurring in the open or under oaks or pines. The following specimens may be cited as fairly typical of the species: Inyo Co.: "Among the sage-brush in the Pinon belt," *Hall & Chandler* 7129 (C). Ventura Co.: Mt. Piños, *Munz* 6973 (B). Kern Co.: Mojave, *Davy* 2615 (C). Los Angeles Co.: Bouquet Canyon, 1917, *Shaw, Spaulding & Walton* (B); north base, San Antonio Mts., *Hall* 3024 (B), Vincent Gulch, *Munz* 6850 (B), Baldy Lookout, *Johnston* 1734 (B), Swartout Valley, *Munz* 4630 (B); Big Rock Creek, San Gabriel Mts., *Munz* 6806 (B). San Bernardino Co.: Cajon Pass, *Munz* 5710 (B); Dark Canyon, Pinecrest, *Munz, Street & Williams*, 2816 (B); Little Bear Valley (Arrowhead), *G. Corwin* (B); Forest Home, *Munz & Harwood* 3837 (B & C); Oak Glen, *R. J. Smith* 3 (C). Riverside Co.: Kenworthy, San Jacinto Mts., *Munz & Johnston* 5471 (B). San Diego Co.: Palomar Mt., 1921, *Snyder* (B), *Munz* 8315 (B); Julian, 1906, *M. E. Jones* (B); Cuyamaca Peak, *Munz & Harwood* 7263 (B), *Munz & Newsom*, in part, 8113 (B); Descanso, 1906, *T. S. Brandegee* (C); Laguna Mts., *Munz* 8371 (B).

At comparatively low altitudes, occasional shade plants have the lax habit and general appearance of *V. pedunculata*, e. g., *Munz & Newsom* 7991 (B), Lion's Valley, San Diego Co.; but a careful examination of such shows that the technical characters of the long, brown rootstock, pubescent capsule, and heavier retrorse pubescence can be relied on to distinguish *V. purpurea*.

In Southern California literature, references to *V. praemorsa* Dougl. and *V. praemorsa* var. *venosa* Gray apparently refer to *V. purpurea* and its variety *pinetorum* Greene.

5. *Viola purpurea* var. *pinetorum* Greene. Fl. Francisc., 243. 1891. *V. pinetorum* Greene Pitt. 2:14. 1889.

Like the species but leaves longer and narrower, lance-ovate to lance-linear, 2-6½ cm. long, 3-12 mm. wide; margin of leaves with fewer teeth, undulate when lanceolate, dentate when lance-ovate; tip acute; leaves often more pubescent, especially on lower surface; petals sometimes smaller than those of the typical form but otherwise the same.

Range and habitat that of species, but distributed mostly from 6,000-10,000 ft. altitude. Type locality: Tehachapi. Type seen. Representative of the variety may be cited the following specimens:

KERN Co.: Tehachapi, 1889, *Greene* (C), *Dudley* 317 (C). VENTURA Co.: Mt. Piños, *Munz* 7020 (B). SAN BERNARDINO Co.: San Antonio Peak, *Wilder* 593 (C); Ontario Peak, *Johnston* 1281 (B & C); near Bluff Lake, San Bernardino Mts., *Munz* 5621 (B). RIVERSIDE Co.: near Tamarack Valley, San Jacinto Mts., *Munz* 6048 (B).

Intermediates in respect to leaf shape between *V. purpurea* and the variety *pinetorum* are as follows: VENTURA Co.: Mt. Piños, *Munz* 7036 (B). LOS ANGELES Co.: Brown's Flats, San Antonio Mts., *Johnston* 1760 (B). SAN BERNARDINO Co.: Mt. San Antonio, *Abrams* 2669 (C); Cucamonga Canyon, *Johnston* 27m (B); San Bernardino Mts., Fredalba, *Munz* 2939 (B); Saw Pit Canyon, *Wilder* 26 (B). RIVERSIDE Co.: Strawberry Valley, San Jacinto Mts., 1901, *Jepson & Hall* (C); Santiago Peak, Santa Ana Mts., *Munz & Keck* 7072 (B). SAN DIEGO Co.: Cuyamaca Mts., *Munz & Newsom*, in part, 8113 (B), 1896, *T. S. Brandegee* (C); Descanso, *K. Brandegee* (C).

6. *Viola chrysantha* Hooker. Icones Plantarum. t. 49. 1837.

Stems sparsely pubescent, 6-10 cm. long, clustered from a thick, erect rootstock with many fascicled, fibrous roots; leaves ovate in circumscription, 1½ cm. long, 2-5 cm. wide, bipinnately 3-5 parted with 3-5 cleft linear lobes, which are 5-10 mm. long and 2-3 mm. broad, villous pubescent to ciliate-pubescent and at times even glabrate; petioles sparsely pubescent, 3-7 cm. long; stipules small, lanceolate, entire, 6-10 mm. long; peduncles at least twice as long as petioles, sparsely pubescent; sepals 4-7 mm. long, lanceolate, ciliate pubescent; petals broadly cuneate, a deep yellow, the two upper ones brown-purple without, edged with yellow, 8-12 mm. long; the two lateral petals bearded near base, brown-purple lines present within; lower petal glabrous, 10-15 mm. long, with a short succate spur 2 mm. long; stigma bearded on sides; capsules ovoid, glabrous, green, 7-10 mm. long.

About meadows and low grassy places at altitudes from 3,000-8,000 ft. KERN Co.: Tehachapi, *Heller* 7834 (C). LOS ANGELES Co.: San Gabriel Mts., between Pine Flats and Chilao, *Peirson* 2447 (B). SAN BERNARDINO Co.: Bear Valley, *Munz* 5653 (B), 1922, *Pierce* (B), *Parish* 1488 (C). SAN DIEGO Co.: Mesa Grande, 1895, *T. S. Brandegee* (C); Julian, 1906, *M. E. Jones* (B), 1901, *T. S. Brandegee* (C); *Davidson* 3593 (B); Cuyamaca Lake, *Spencer* 1440 (B), *Munz & Harwood* 7282 (B), *Munz & Newsom* 8102 (B); Laguna Mts., *Munz* 8430 (B).

Southern California references to *V. Douglasii* Steud. apparently refer to this species.

7. *Viola Sheltonii* Torr. Pac. R. R. Rep. 4:67 pl. 2. 1856.

Stems glabrous or finely pubescent, ascending or spreading, 5-20 cm. long, from a thick rootstock with numerous fleshy roots tending to be fascicled; leaves reniform-cordate in circumscription, 3-5 cm. long and 5-7 cm. wide; segments nearly sessile, each often palmately tridivided with 2-5 parted segments irregularly 2-5 cuneate cleft or lobed, each lobe rounded at tip and very slightly mucronulate, ultimate segments fused and fan-like at base, finely puberulent, appearing glabrous, with very short, fine ciliation; lamina slightly decurrent down petiole; petioles 3-15 cm. long, sparsely puberulent; stipules small, 3-4 mm. long, ovate to obovate, deeply cut or incised at tip, appearing like long hairs, rarely almost entire; peduncles slightly longer than petioles, finely puberulent or glabrate; sepals lanceolate, glabrate, 8-10 mm. long; margin slightly scarious; petals elliptical to obovate, yellow with brown-purple veinings without; upper petals 12-15 mm. long; lateral petals 11-14 mm. long, not bearded; lower petal 15-17 mm. long, with short saccate spur 1-2 mm. long; stigma not bearded; capsule ovoid, pubescent, yellow-brown, 7-10 mm. long.

Shaded banks and canyons from 4,000-6,000 ft. altitude: LOS ANGELES Co.: Brown's Flats, San Antonio Mts., *Johnston* 1759 (B);

Cucamonga Canyon *Johnston* 1303 (B) and April 1, 1917, *Johnston* (B). ORANGE CO.: Santiago Peak, *Peirson* 3496 (B).

The collections from the San Antonio Mts. were reported as *V. lobata* Benth. by Johnston (Bull. So. Cal. Acad. Sci. 17-65. 1918) and by Davidson & Moxley (Fl. So. Cal. 238. 1923) and referred to *V. Sheltonii* Torr. by Munz & Johnston (Bull. Torr. Club. 49:353. 1922).

8. *Viola lobata* Benth. Pl. Hartweg. 298. 1839.

Rootstock short, thick ascending, with many fascicled fleshy roots; stems erect, glabrate, 7-25 cm. long, solitary, or in groups of not more than three, with upper internodes of stem short; leaves cordate to hastate in outline, 2½-6 cm. long and 3-4½ cm. wide, varying from leaves entire with margin crenate to dentate, to leaves palmately 3-parted, with central part sinuous lanceolate, and the lateral parts narrowly 2-5 lobed; surface often densely pubescent, becoming short hirsute; base moderately reniform; tip acute to acuminate; petioles pubescent, 3-12 cm. long, the basal ones being much the longer; stipules 5-9 mm. long, lance-ovate, slightly dentate; peduncles pubescent, 3-7 cm. long; sepals lanceolate, glabrate, 5-7 mm. long; margin slightly scarious; petals broadly cuneate; upper petals 11-15 mm. long, a clear yellow, brown-purple without, darkening with age; lateral petals 11-15 mm. long, a clear yellow with 2 dark brown-purple lines within, more or less brown-purple without, clavate bearded near base; lower petal 13-17 mm. long, a clear yellow with dark brown-purple lines present, often very faintly brown-purple without; stigma short bearded; capsule ovoid-oblong, glabrous, yellow-brown, 8-10 mm. long.

Locally abundant in leaf mold under firs aand oaks, at from 5,000-6,000 ft. altitude in the Cuyamaca Mts., San Diego Co. Other Southern California localities for this species apparently refer to *V. Sheltonii*, q. v.

Specimens have been found in the following localities in Southern California: SAN DIEGO CO.: Cuyamaca Peak, 1896, *T. S. Brandegee* (C), *Munz & Harwood* 7252 (B), *Munz & Newsom* 8121 (B); Scenic View, south of Julian, *Munz* 8328 (B).

Our material differs from northern material in its smaller stipules.

Field observation would indicate that the variety *integrifolia* Watson (Proc. Cal. Acad. Sci. 2:185. 1863) is nothing but a minor variation and not deserving of varietal rank. However, according to Brainerd (Vt. Bull. 224:123. 1921), "it is evident in the light of recent discoveries, that we have here a case of dimorphism, where a species and its variety for successive generations interbreed."

9. *Viola adunca* J. E. Smith. Rees's Cyclopedia 37, Viola No. 63. 1817.

V. canina var. *adunca* Gray. Proc. Am. Acad. 8:377. 1872.

Rootstock often slender; stems clustered, 4-10 cm. long, downy pubescent; leaves oblong-ovate to cordate, somewhat flatly crenate, downy pubescent to glabrate; blade 1½-3½ cm. long, 1-3 cm. wide; tip round obtuse; petioles finely pubescent, 1-10 cm. long; stipules rather large, foliaceous, linear to lanceolate, 10-15 mm. long, with margin more or less incised; peduncles almost twice the length of petioles, glabrate; sepals lanceolate, glabrate, 5-7 mm. long; margin slightly scarious; petals a deep blue with dark veinings, paling with age, 12 mm. long, elliptical to obovate; lateral petals bearded near base; lower petal with a long and at least slightly hooked spur which is 8-10 mm. long and 2-3 mm. wide; stigma with a distinct, persistent, long beard; capsule glabrous, greenish-brown, oblong, 7-9 mm. long; cleistogamous fruit abundant in late summer.

On gentle slopes at the edges of meadows in the Transition Zone, from about 5,000 to 8,000 ft. altitude. Specimens have been seen from but two counties: SAN BERNARDINO CO.: Talmadge's Mill, San Bernardino Mts., *Parish* 3398 (C); near Bluff Lake, *Munz* 5628 (B). SAN DIEGO CO.: Palomar Mts., 1921, *Snyder* (B), Doan's 1896, *McClatchie* (C), *Munz* 8246 (B).

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The 1922 issues are: Vol. XXI, No. 1, March; Vol. XXI, No. 2, September.

The 1923 issues are: Vol. XXII, No. 1, March; No. 2, July.

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DR. JOHN A. COMSTOCK, *Secretary*

Southern California Academy of Sciences, Southwest Museum
Los Angeles, California.

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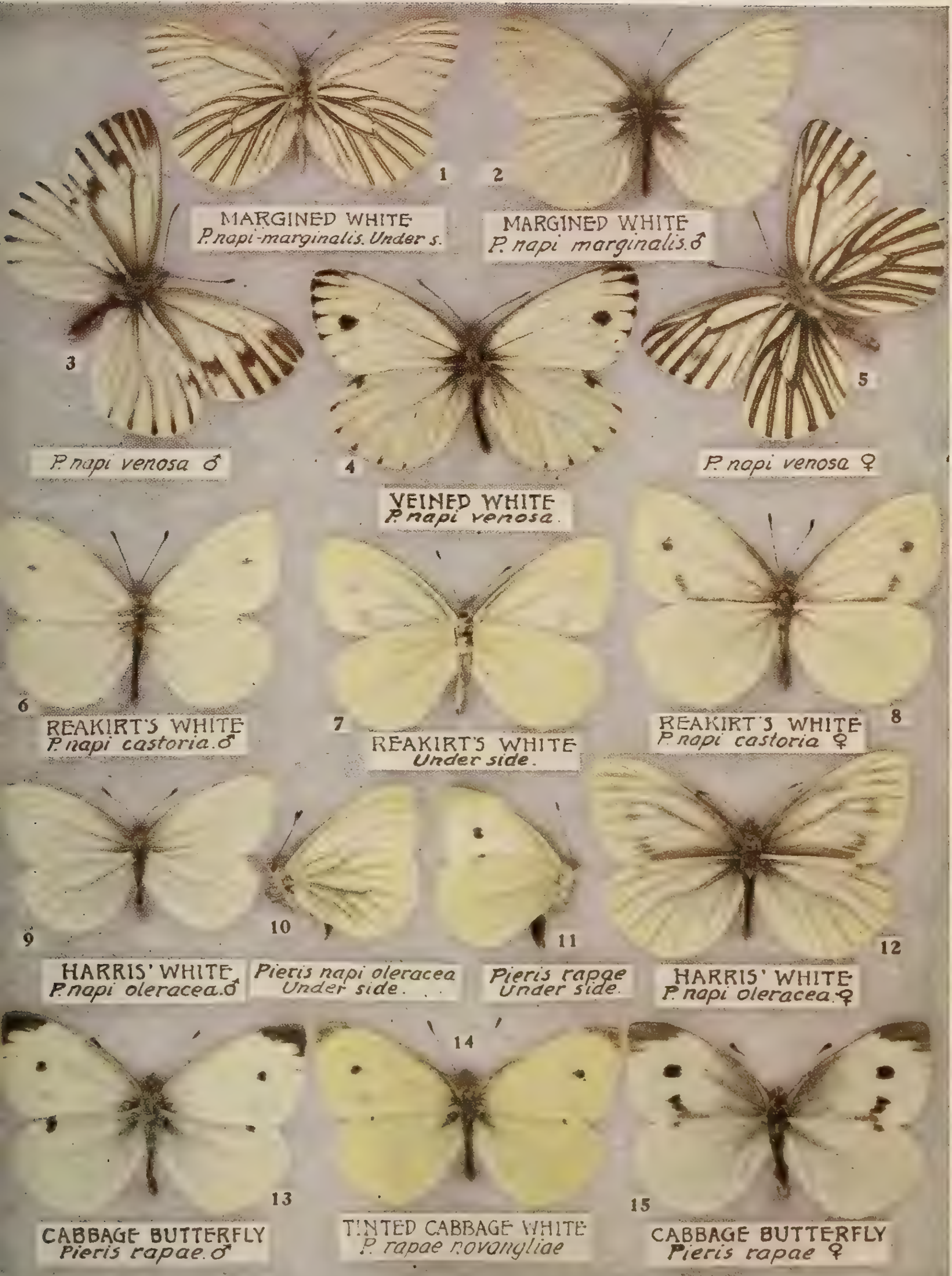

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STUDIES IN PACIFIC COAST LEPIDOPTERA

Continued

DR. JOHN A. COMSTOCK

A NEW MELITAEA FROM OREGON

Collecting in the vicinity of Crater Lake, Oregon, in the late summer of 1923 was productive of a generous list of diurnals, one of which proves to be a new species.

MELITAEA BRIDGEI, sp. nov.

Male. Superior surface.

Primaries. Ground color, brownish black, fringes black interspersed with a few yellowish scales; a narrow orange brown or ferruginous marginal line, interrupted at nervules; internal to this a series of six to eight lunate or irregular spots, the largest being placed between the second and third median nervule; internal to this a sinuous row of six to eight quadrate or irregular spots a shade lighter in color than the previous two rows. Internal to this is a fourth row of still lighter quadrate spots, seven in number; those in the radial interspaces tending to fuse with equivalent spots of the third row. This row is formed in a sinuous line, the upper portion strongly concave medially. Two small orange-brown spots are placed lateral to the discocellulars. Two elongate spots occur in the lateral portion of cell, the medial one being lighter in color. Three or four small irregular spots occur in the basal portion of cell and one or two round or irregular spots are placed just below the cell.

Secondaries. Ground color and series of spots of same shade as corresponding rows in primaries. Fringes, creamy yellow, interrupted with black at ends of nervules; marginal row of six or seven narrow elongate spots; submarginal row of lunate or irregular spots, largest in second and third median interspaces; internal to this a row of five or six irregular spots. A fourth row of seven or eight quadrate or irregular spots in the limbal area, concave medially. Basal area completely brownish-black except for two spots in outer portion of cell, the lateral of which is lunate, while the medial is a mere point of a lighter color.

Male. Inferior Surface.

Primaries. A submarginal line corresponds to the same line on superior surface, but is more clearly defined, and interrupted at nervules by narrow black lines; internal to this a row of eight lunate, yellowish spots, shaded internally by a wide black band. The third and fourth rows of spots have fused so as to form a continuous band covering most of the limbal area, with fine black streaks on the nervules, dividing it into elongate quadrate spots. The ground color of this band is orange-brown, but medially it shades to a creamy buff Medial to this are numerous irregular spots on a black ground. The cell is orange brown, except for a band of creamy buff crossing the outer third, and edged with black, and an irregular spot in the inner third, similarly colored and edged.

Secondaries. Narrow submarginal line as on primaries, with similar interruptions at nervules; internal to this seven lunate spots of a clear creamy yellow, the largest placed between the second and third median nervule. Internal to this a black irregular line medial to which is a row of seven quadrate or irregular spots, the two nearest costa, creamy yellow, the remainder orange-brown; internal to this a broad band of irregularly quadrate creamy yellow spots separated by the black lines of the nervules, and also crossed transversely by two sinuous black lines, one laterally, the other medially placed. Basal area orange-brown with from four to six irregular creamy-yellow spots, bordered with black.

Head, thorax and abdomen; black above, creamy yellow below.

Antennae; black, finely annulated with yellow, club tipped with yellow buff.

Expanse. Male $1\frac{3}{8}$ in. (35 mm.) Female $1\frac{1}{2}$ in. (39 mm.)

The female differs from the male principally in the fact that the series of lighter colored spots are more pronounced and of a lighter shade.

Types: Holotype, male. Crater Lake, Oregon, August 2, 1923.
Allotype female. Crater Lake, Oregon, August 2, 1923.
Paratypes Nos. 1 to 11, all taken at Crater Lake, Oregon, August 2, 1923. Ten males. One female.

The holotype, allotype, and eight paratypes, in the collection of the Southwest Museum, Los Angeles, California.

Paratype No. 9, deposited with Dr. Wm. Barnes, Decatur, Illinois.

Paratype No. 10, deposited with the National Museum.

Paratype No. 11, deposited with the Canadian National Collection, Dr. McDunnough, Ottawa, Ontario, Canada. The holotype, allotype and paratype No. 1 to be subsequently shown in colors on plate No. 38.

This species is intermediate between whitneyi Behr. and hoffmani Behr. It is darker than either species. From hoffmani it may be distinguished by the fact that the lighter yellowish band of spots in the limbal area, superior surface, is only half the width of hoffmani. This band, in the last named species tends to fuse with the third band throughout almost its entire length. The colors are very close in both these species, whereas in whitneyi, they are of a more ruddy hue.

I take pleasure in naming this species for Dr. Norman Bridge, whose interest in and support of science receives all too little recognition in proportion to the good works for which he and Mrs. Bridge are responsible. This, I make bold to do without asking his permission.

Notes on the Genus Cercyonis

By John Adams Comstock

In the "Bulletin" for January-February 1924 we published a paper on **Cercyonis stephensi Wright,** in which it was demonstrated that the "species" was only a color form of the insect which has been held in collections under the name **gabbii.** In order to fix the place of the latter species reference was had to Boisduval's original description and also to Oberthur's excellent figure of the types in his Volume IX Etudes de Lepidopterologie Comparee. We were at once impressed with the fact that his figure ♂ 2180 represented the species that we have been calling gabbii, while the ♀ 2181 more nearly approaches C. boopis. In order to make certain of our point, a specimen of our so called gabbii was sent to Drs. Barnes and Benjamin at Decatur for determination, and a series was sent to Dr. Oberthur, together with one specimen of our so called ariane.

Dr. Benjamin reported that "the Satyrid you sent I have been calling S. gabbii. We have five from Dr. Lindsay's trip through Modoc County."

Dr. Oberthur's reply was so enlightening on several points that his entire letter is here incorporated.

October 31, 1923.

"Dear Dr. Comstock:

Thanks for the documents which I received from you recently.

I can give you the following information concerning Satyrus ariane Boisduval:

On page 21 (Lepidoptera of California, Brussels, 1869) Boisduval writes as follows:

'Wings black-brown, forewings have dark eyes on both sides with brown iris and white pupil, hind wings underneath with two dark wavy streaks, six eyes many small faded ones worn out.'*

This is exactly the ♂ which I have. I am showing the Boisduval type under the No. 2180 on plate CCLX in Vol. IX of 'Etudes de Lepidopterologie Comparee.'

The female No. 2181 (many small worn out faded eyes) does not seem to be typically like the male No. 2180. Isn't that a very large female of another species?

On page 62 of the mentioned book, 'Lepidopteres de la Californie' Boisduval says, 'Mr. Lorquin sent us, as a new species, a variety smaller than the type which we described. It does not differ from the ordinary specimens, except that the females have eyes with less pronounced iris and the design on the under side is less clear.'

Boisduval has not named this new species of which he has two males and one female in his collection next to the ariane.

Lorquin was right in saying that he sent a new species different from ariane.

From all this the result is that the real ariane Boisduval shown under No. 2180 (plate CCLX Vol. IX Lepidoptera Comparee) is the species which you sent me under the name gabbii.

The name gabbii should be changed to ariane.

With regard to the Satyrid which you sent me under the name ariane, this is exactly the new species, according to Lorquin, not named by Boisduval, but which he mentions on page 62 of his book, "smaller, design on underside less clear.

Regarding the ocelli with the iris less pronounced in the females, (just as in the ♂♂ it is certain that ariane Boisduval ♂ (fig. 2180) has much stronger ocelli on the underside of the lower wings (secondaries) than the new species of Lorquin.

To conclude, ariane Boisduval ♂ originally described, is the one shown in fig. No. 2180 and only the flies which are corresponding with this fig. 2180 should be named ariane and your ariane, should have a new name.

The pictures which I have published from 'Specimina typica americana Boisduvaliana' have given rise to many interesting corrections in regard to the naming of the Californian species of Lepidoptera and the pairing of the sexes in the Hesperidae.

Mr. Lindsay writes me as follows and I think that he is right:

According to my notes, the figure 2088 (plate CCXL Vol. IX Lepid. Comparee) pratincola ♂ appears to be **nemorum** as you suggest, while 2089 is the ♀ of sylvanoides Boisduval. Your fig. 2085, one of Boisduval ♀ sylvanoides represents campestris ♀ while your figures 2083 and 2084 represent the two sexes of sylvanoides. The ♂ type should of course fix the species.' (I believe he should have said "represent two males of sylvanoides").

There is no doubt that it would be very instructive to publish more about the synonymy of the different Californian species of Lepidoptera described by Boisduval and the errors which this author might have made.

To-morrow begins the New Year 1924. Please accept my best wishes of good luck for you and all those who are dear to you."

Cordially yours,

Charles Oberthur.

Boisduval evidently drew his description from a mixed series containing two forms, since the female chosen by Dr. Oberthur is obviously the form **boopis**. It is reasonably certain also that this series does not contain the dark form that has been considered as **ariane** by most of the American lepidopterists. Dr. Oberthur's letter strongly suggests the desirability of restricting the type to the specimen which he has figured, (2180) and I propose in this revision to so

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*The original description is as follows:

"59. **Satyrus Ariane,** Boisd.

Alae nigro—fuscæ; anticæ utrinque oculis duobus atris, pupilla alba iride fulvo; posticæ subtus strigis duabus undulatis obscuris, ocellis sex plus minusve obsoletis.

Il a la port et la taille de notre **Phædra,** et droit être placé entre cette espèce et l'Alope des autres parties des Etats-Unis.

Commun en juillet dans les forets herbenses."

restrict it. This leaves for our consideration the true status of the dark form above referred to. In this connection I have received from Dr. Benjamin a letter which throws valuable light on the subject and from which I quote.

"We have a specimen marked **typical incana X. T. Edw. Coll J. McD.** This is your incana, apparently common in Plumas Co."

Incana was placed by Dr. McDunnough as a synonym of **ariane Bdv.** after having made this comparison. **Incana** is therefore available to cover this dark form, without the necessity of erecting a new name as suggested by Dr. Oberthur.

I have long suspected that **C. wheeleri** was only a form of what we have been calling **gabbii**, (the true ariane Bdv. as above) in which the anterior ocellus was paired. The following quotation from Dr. Benjamin (in litt) confirms this. "I have examined the types of **hoffmani** Strkr.—not a hurried examination with lack of material at Chicago, but a careful study **here.**

Mr. Gerhart brought them to me and I had the chance to compare them with all our material. There can be little doubt but that **hoffmani** was named from type material which also supplied the types of **wheeleri** and that both of these names are synonyms, **wheeleri** having priority. . . . . . with a long series of **gabbii** before us we are inclined to regard **wheeleri**, (judging from the types of **hoffmani**) as simply a local race of **gabbii**, with an extra spot on the primary. Specimens of **gabbii** from Modoc County, California, are otherwise extremely close to the types of **hoffmani.** The elongation of the spots on the underside of the secondaries are practically duplicated in occasional **gabbii.**"

Grinnell's description of C. behri would seem to place it in the paulus sylvestris group although we have no specimens from Mt. Tamalpais that exactly tally with the description.

The California Cercyonids would therefore be grouped as follows:

1. Cercyonis alope ariane Bdv.
   gabbii Edw.
   form ♀ stephensi Wright.
   a. wheeleri Edw.
      hoffmani Stkr.
   b. boopis Behr.
      form incana Edw.
      form baroni Edw.
2. C. sthenele Bdv.
3. C. silvestris Edw.
   okius Oberth.
   a. paulus Edw.
   b. behri Grinnell.?
4. C. oetus Bdv.
   charon Edw.

Notes on the Genus Pieris and Eurymus

In a previous paper* I called attention to the fact that the yellow form of Pieris sisymbrii had been named flava by Edwards notwithstanding the fact that he had used the same name within the genus for a yellow form of P. napi. This raises the point as to whether it is permissible to use the same name for forms of two closely related species within a single genus. I have felt that a practice of this type would lead to considerable confusion and since the primary purpose of creating names in order to differentiate between certain conditions is only one devised for greater clarity, I considered it justifiable to rename the form flavitincta.

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*Bulletin Southern California Academy of Sciences, Vol. XXIII, Part 1, 1924.

In a recent letter from Dr. Benjamin he has pointed out that there is no definite rule thus far created to establish the point, and some authorities may differ on the propriety of the new name.

I would, however, point out that Dr. McDunnough has stated in a letter to me that "'flava' is preempted in the genus for a form of napi and is therefore not available," which would seem to lend his concurrence in my opinion.

In the case of Eurymus we have the albinic female of eurytheme named alba Edw. and the same name has also been applied to the white female of the sub-species amphidusa. This well illustrates the confusion that would arise were this practice to be generally followed. I believe, therefore, that we should use the later designation for the albinic female amphidusa which was given to it by Cockerell, namely pallida. While I have not used these names in labeling my plates I propose to include them in the text of my forthcoming work on the Butterflies of California.

It is to be hoped that a ruling will be incorporated in the international code determining this point.

BUTTERFLIES OF CALIFORNIA

—— By ——

DR. JOHN A. COMSTOCK

(Continued from September-October Issue)

The last issue of the "Bulletin" concluded our treatment of the Genus **Pieris.** One exceedingly common variety has not been included in the colored figures, but is briefly mentioned here—i. e., the spring form of the **Cabbage Butterfly.** This was named **immaculata** by Skinner and Aaron. It may be distinguished from the typical **rapae** by its somewhat smaller size, and lack of spots on the upper and under side of primaries. It represents the brood that emerges from overwintering pupae. Color Plate IX of this issue, illustrates the species which were included in our text of the July-August and September-October issues, pages 124, 125, and 157. The footnote on page 125 should be corrected to read—The types and cotype No. 1 are accurately pictured on **Plate VIII,** figures 12, 13, 14, to be subsequently published in the Bulletin.

GENUS NATHALIS Boisduval.

The Dwarf Yellows

The Dwarf Yellow (Nathalis iole Bdv.) occurs in the southern portion of the state, and has been reported sparingly as far north as Inyo County. It is a lowland and foothill species, with a tendency to confine itself to restricted localities, and to be erratic and irregular in appearance. It is on the wing from February to September, with probably two or more broods to account for its long season. The larval foodplants are Erodium (alfilerilla) Dyssodia (fetid marigold), Helenium (sneezeweed) et cetera. The species is pictured on Plate X, figures 1 to 3.

GENUS EUCHLOE Hubner

The Marbles

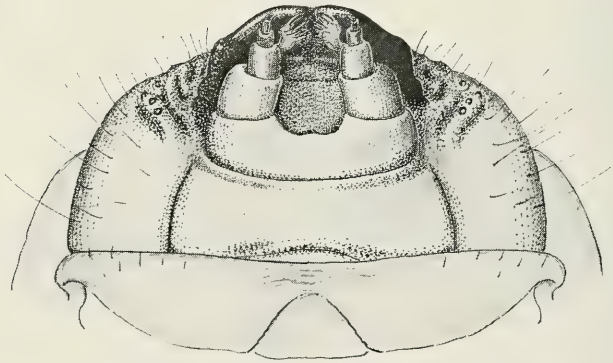
Edward's Marble (Euchloe creusa hyantis Edw.) and the **Southern Marble** (E. creusa lotta Beut) represent two races of a species of butterfly, the typical form of which does not occur in California. Both varieties are rare. They should be sought in the early months

of spring. The **Southern Marble** particularly, is one of the first butterflies to appear on our desert uplands, such as the Mojave, and the San Gorgonio Pass. **Edward's Marble** is usually later in appearance, due to the retarded season at higher altitudes, where it seems to be the characteristic form. At elevations of eight thousand feet or more it may not appear until July. Little is known of the early stages, but they are probably similar to other nearly related species in the genus. The two forms are pictured on Plate X. Edward's Marble may be distinguished from the Southern Marble by the heavier green mottling on the under side of secondaries, and the narrower spot at the end of the cell in the primaries.

The Large Marble (Euchloe ausonides Bdv.) occurs in California only on the coastal plains and in the Sierras of the central to northern counties. It is never abundant. In the lowlands it is most frequently taken in April and May, but the retarded seasons of the alpine regions hold back its appearance in our mountain districts until midsummer. Two color forms have been distinguished. The **Yellow Marble** (E. ausonides flavidalis) is characterized by a complete suffusion of dull orange yellow, and the **Half-Yellow Marble** (E. ausonides semiflava) has the secondaries suffused, while the primaries are white.

The larval foodplants include various cruciferae, of which the tower and hedge-mustards are most favored. All of the above are pictured on plate X which will be subsequently published in the "Bulletin."

PLATE 1.



Head of Desmocerus californicus. (Horn.)
Ventral Aspect Greatly Enlarged.

LARVA AND PUPA OF DESMOCERUS CALIFORNICUS. (HORN)

BY ALONZO DAVIS
and
JOHN ADAMS COMSTOCK

This uncommon Southern Californian insect was first described by Dr. George Horn in 1881. (Trans. Am. Ent. Soc. IX, 1881, p. 7.) His description is as follows:

D. californicus—black opaque, elytra bluish or greenish black, narrowly margined at base and sides with orange-red. Head and thorax densely and moderately coarsely punctured, the latter with the surface regular, and with a slight tinge of bluish-green. Elytra densely punctured, the punctures near the base coarse and deep, becoming gradually finer and denser toward the apex, surface black opaque and with a bluish, violaceous or greenish tinge, the lateral and basal margins narrowly orange-red, scutellum and a small spot on each side black. Body beneath and legs densely and rather finely punctured, the metasternum very finely pubescent. Length .64♂—.84♀ inch:—16-20 mm.

The adult insects emerge in late March or early April, and may be occasionally taken resting upon the leaves of the food plant, the elder (**Sambucus glaucus**), usually at midday, resting on leaves exposed to the sun. They are not very wary, and when seen may be secured without much difficulty.

In December 1923, I secured two pupae and four larvae of this insect from elders growing in a canyon wash near Pasadena.

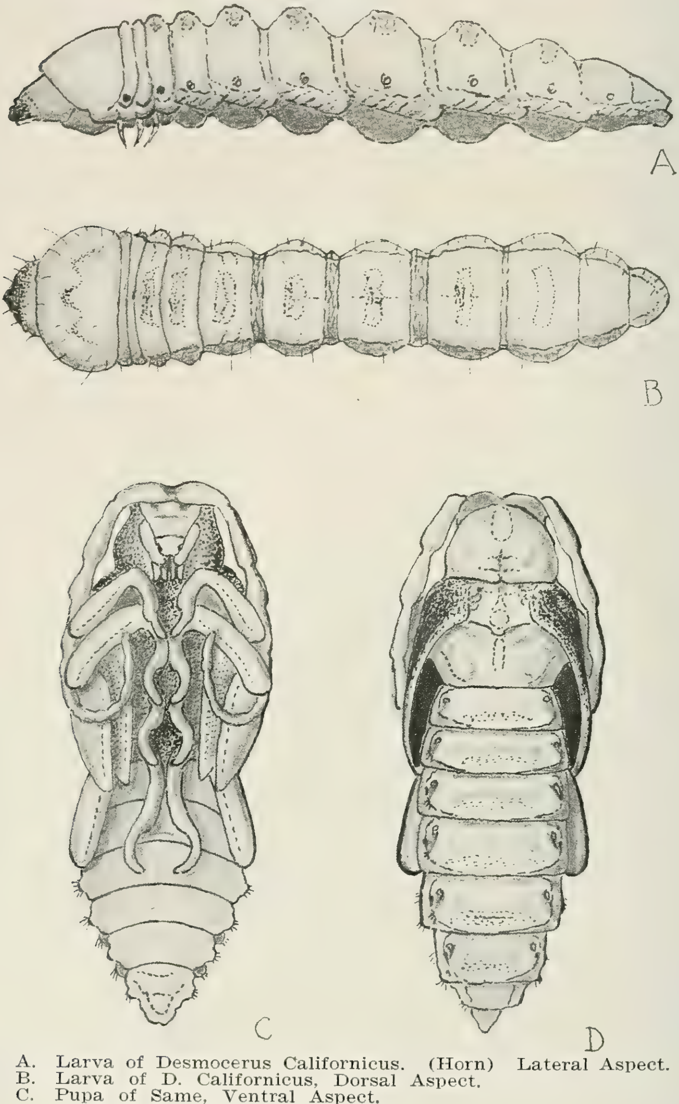
Larva: Form elongate, subcylindrical, the thoracic segments flattened above and beneath, integument shining, almost glabrous, color yellow-white, head light yellow-brown, mandibles black.

Head: Sub-orbicular, somewhat flattened, tapering in front, inserted into the prothorax about half its length. Exposed portion chitinous, yellow-brown, minutely alutaceous, sparsely clothed with brown bristles on front and sides. A brown depressed median line at the basal two-thirds, frontal sutures depressed, yellow, a transverse yellow suture just back of the epistoma. Epistoma dark brown, heavily chitinized, somewhat thickened at anterior edge into a transverse ridge, bearing a small transverse depression each side of the median, from which grows a single seta. Two other setae spring from small round pits close together on the anterior edge near the dorsal mandibular articulation. Clypeus thin, trapezoidal, transverse, shining yellow-white, brown along anterior edge. Labrum transversely oval, about 2½ times as wide as long. A dense mat of short brown bristles conceals the anterior margin. Antennae very short, three-jointed, retractile. Three black, beadlike ocelli. Submentum transverse, subcordate, whitish. Mentum trapezoidal, nearly square, with fine striae on the anterior half. Ligula ovate, almost hidden by stipes and palpi, several coarse brown setae on surface, anterior edge rounded and very finely ciliate. Labial stipes prominent, brown at basal half. Palpi two-jointed, short and stout, joints oval, brown, the first a little longer than and about twice as wide as the second. Maxillae: cardo diamond-shaped, white, separated from the maxillary sclerite by an indistinct depressed line. Stripe transversely oval; palpifer nearly square, lacinia stout, cylindrical, length equal to first joints of palpus, brown, rounded at tip, bearing many coarse brown bristles, especially on the inner apex. Palpus three-jointed, the second

equal in length to, and about half as wide as the first, the third narrower, conical, rounded at tip. Anterior margin of hypostoma dark brown, retracted at middle. Gula not distinct.

Prothorax transverse, tapering in front, widest at middle. Pronotum shining, anterior third yellowish, marking insertion of head, sparsely punctate except on extreme anterior margin, and alutaceous between punctures. A few long, brown hairs, especially at sides. Posterior quite strongly reticulate, an oblique depression in the posterior half, about two-thirds laterally from the median.

PLATE 2.



A. Larva of Desmocerus Californicus. (Horn) Lateral Aspect.
B. Larva of D. Californicus, Dorsal Aspect.
C. Pupa of Same, Ventral Aspect.
D. Pupa of Same, Dorsal Aspect.
All figures enlarged.

Meso and metanotum short, broad, surface not shining, the former bearing the first spiracle, which is vertically elongate, about twice as long as wide. Legs well developed, robust, anterior pair shortest. Coxae widely separated, short, conical; trochanter short and broad; femur stout, widest at basal third. The inner face of trochanter and femur bear several brown hairs. Tibia subequal in length to the femur, but narrower, apex brown, chitinous; tarsus long, (equal to ½ the tibia) acute, tip chitinous, recurved. Metathorax larger than mesothorax. Eusternum somewhat transverse, triangular, broadly rounded anteriorly, glabrous except for a few brown hairs, surface dull.

Abdomen—Ampullae (segs. 1-7) broad, somewhat flattened, tubercles large, confluent, a transverse lateral impression just back of the middle on segments one to five, and an oblique line anterior on all segments cutting off a small triangle next to the anterior median on each side. Posterior borders of ampullae ill-defined on most segments. Epipleurum distinct on all segments. Pleural tubercle narrowly oval, bearing, on segments one to six, two long setae and one or two fine hairs below; and on segmnets seven and eight, three long setae and from one to four fine hairs. Eighth segment smooth and shining dorsally. Ninth with tergum broad, bearing numerous setae, especially along the raised posterior and lateral margin. Anal lobes projecting slightly, the dorsal one bearing several long setae on each side, dorsally and laterally. Spiracles oval, deep, peritreme thin.

Pupa: White, head and thorax resembling adult except that they are impunctate, or nearly so. At base of head, dorsally, two small tubercles, one just each side of the median, which apparently do not appear in the adult insect. Head bent under the prothorax so as to be hardly visible from above. Anterior region of Pronotum tuberculate centrally, and bearing a few brown hairs. A deep median groove in the basal two-thirds with a group of brown hairs on either side.

Meso and metathoracic segments visible from above, the latter impressed along the median, and both alutaceous, with a series of short impressed lines extending laterally from the median. Scutellum prominent, nearly circular. Elytra veined, bent beneath the thorax between the middle and hind legs. Legs folded. Several long brown hairs near the tip of each femur.

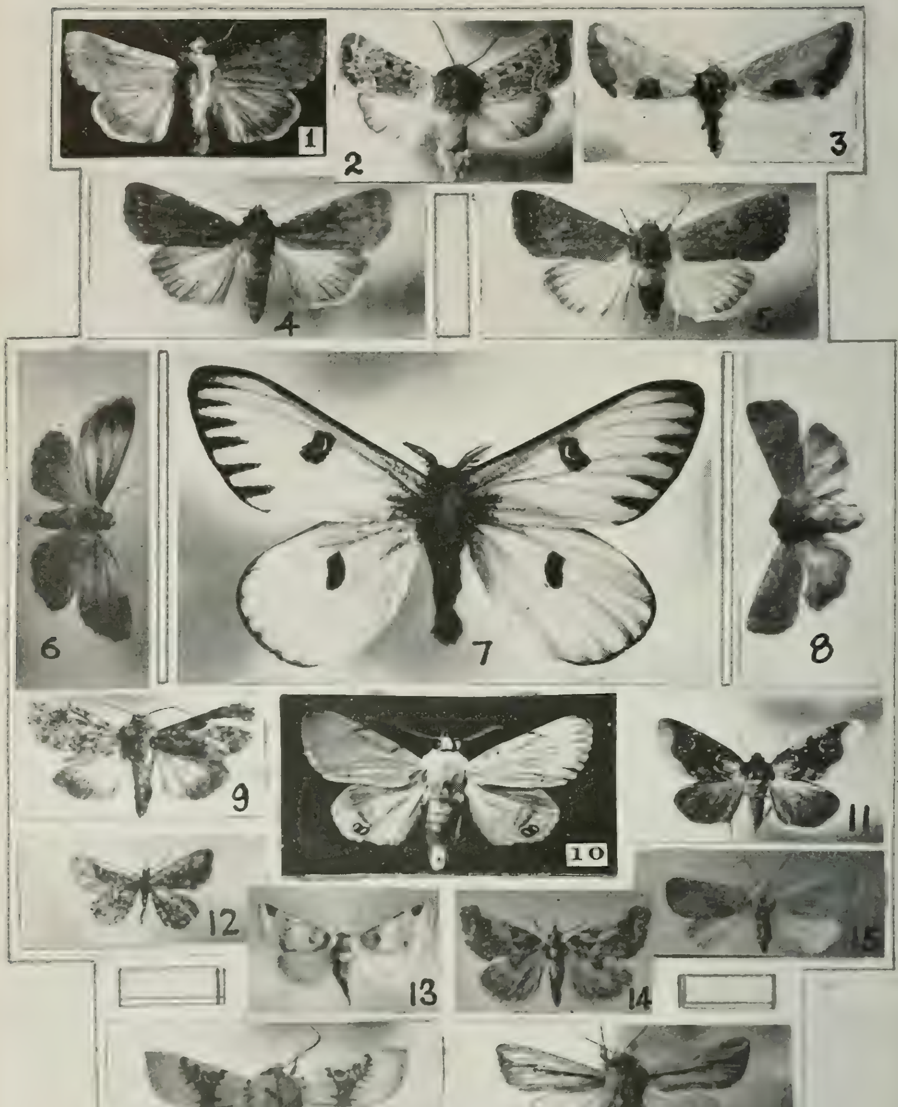
Abdominal segments one to six bearing numerous short, straight spines at sides and on transverse raised areas just forward of the posterior margins. Segments seven to nine bearing long attenuate hairs from chitinous pores. Ninth with two short, widely separated, conical, chitinous tipped spines extending posteriorly and slightly laterally from the dorsal apex.

Antennae bent under the thorax between the second and third pair of legs, thence curled forward and outward. The apical joint has an impressed ring at about the center, appearing almost as two joints, as is the case, though less noticeably so, in the imago.

The larvae evidently work underground in the roots, until ready to pupate, since only pupae and fully grown larvae were found in the trunk and limbs.

The pupal chamber is in the center of the limb, the pith being almost entirely removed for two or three inches. About four inches above the chamber there is a short transverse burrow, leading almost at right angles to the outside, where the bark is reduced to paper thinness, but never entirely broken through.

The coarse crass from this burrow is used by the larva to form loose plugs for about three inches below, and one inch above the pupal chamber. The pupa is in the bottom of the chamber, head toward the exit hole, the cast-off larval skin forming a sort of cushion for the tip of the abdomen.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PACIFIC COAST LEPIDOPTERA No. 1 (Noctuidæ)

SOME APPARENTLY NEW SPECIES OF MOTHS OF THE FAMILY NOCTUIDÆ AND ONE SATURNID ABERRATION

—— From ——

THE SOUTHWESTERN UNITED STATES

By CHAS. A. HILL
Glendale, California.

List of Species described in this paper as being new to science.
Plate No. 3.

Figure 1—Trichoelea edwardsi deserticola. form nov.
" 2—Euxoa difformis. Smith.
" 3—Stiria dyari. sp. nov.
" 4—Euxoa cinibarina. sp. nov.
" 5—Namangana funeralis, sp. nov.
" 6—Chamoclea comstocki. sp. nov.
" 7—Pseudohazis hera marcata, aberration gunderi. ab. nov.
" 8—Euxoa obscura. sp. nov.
" 9—Oncocnemis wilsonensis. sp. nov.
" 10—Litoprosopus coachella—Hill. "Eut. News," April, 1921, pp. 105.
" 11—Chamoclea benjamini. Hill. Bull. So. Cal. Acad. Sc., Sept.-Oct., 1924, pp. 158.
" 12—Mycterophora geometriformis. sp. nov.
" 13—Schinia coolidgei. sp. nov.
" 14—Plusiadonta compressipalis, suffusa. form nov.
" 15—Schinia silveroides. sp. nov.
" 16—Perographa palomarensis. sp. nov.
" 17—Cirphis februalis. sp. nov.

Fig. 1. Trichoclea edwardsi deserticola.

Head, collar, thorax, abdomen, and antennae concolorous with primaries, a delicate flesh tint. All the ordinary spots obsolete. T. P. line indicated by a row of black dots, as is the terminal line. The reniform in some specimens is slightly defined by a somewhat darker shade. Secondaries white, shading to a darker wide band from exterior line to fringe which is white.

This form differs from typical edwardsi in that the habitus is more obscure, flesh tint in place of grey, and secondaries white to flesh tint in place of grey smoky in edwardsi. Expanse 35 mm. Described from sixteen specimens about equally divided as to sex.

Type locality Indio, Riverside County, California, October 16 to 30th, by E. Piazza, at light.

♂ holotype, ♀ allotype and fourteen paratypes all in coll. Hill.

Fig. 2. Euxoa difformis—Smith.

This species seems referable to above name and the author hesitates to describe a new "Euxoa" for the present, this genus being in an unstable State, according to Mr. F. H. Benjamin.

Fig. 3. Stiria dyari.

Antennae finely ciliate, head yellow, collar heavily tufted with greyed lavender scales. Primaries deep to light cadmium, yellow primaries with a quadrate lavender patch on inner margin centrally, and an irregular broad patch of same color along outer margin, be-

coming broadest from vein VI to III. Fringe concolorous, with markings and thorax.

There is a faint indication of the reniform T. A. and T. P. lines.

Secondaries clearly white except a faint line of a luteous shade before fringes, which are white.

Expanse 31 to 35 mm. Sexes similar.

Described form 5 ♂ and 3 ♀.

Types in coll. Hill.

♂ holotype, San Diego, Calif., April 12. ♀ allotype, Palm Springs, Calif., April 19. Paratypes 4 ♂ and 2 ♀ Palm Springs, various dates.

This species has its closest ally in S. rugifrons with the following points of distinction:

Basal dash is absent, secondaries are clear white as against a luteous shade in rugifrons is slightly smaller and patch on inner margin is quadrate, not rounded.

Fig. 4. "Euxoa" Cinibarina.

Antennae finely ciliate. Head and thorax concolorous with primaries which are brownish purple, giving the insect a coppery aspect. Ordinary spots obsolete, basal line and S. T. line defined by light scales. T. A. and T. P. lines black. Secondaries smoky to white inwardly.

Expanse 38 mm.

Described from two specimens ♂ holotype and ♀ allotype taken on Mt. Wilson, 6000 feet elevation, Los Angeles County, Calif., at light by E. Piazza.

Types in coll. Hill.

I am in doubt as to the exact generic position of this species.

Fig. 5. Namangana funeralis.

Anntenae ciliate. Head, thorax and abdomen concolorous with primaries, a shiny grey black to black and the reniform only visable, being defined by lighter scales. All the other ordinary marks else obsolete.

Secondaries white with contrasting exterior line, of a smoky shade which also defines the venation inwardly.

Expanse 28 mm.

Described from six specimens. ♂ holotype, ♀ allotype and four paratypes, ♂ and ♀.

Types in coll. Hill.

Type locality, San Diego, Calif., in November.

This may prove to be N. andrena—Smith, but is much darker.

Fig. 6. Chamoclea comstocki.

Antennae ciliate. Head, thorax and abdomen yellow.

Basal area purple; median area shiny, creamy white, thence smoky grey to and including fringes with purple defininatherenation. There is a purplish irridescence to the entire insect.

Secondaries smoky, shading into yellow at inner margin.

Expanse 30 mm.

Described from 2 ♂s taken in Southern Arizona, July 21, 1923. ♂ holotype and 1 ♂ paratype in coll. Hill.

It is a pleasure to name this little beauty in favor of Dr. John A. Comstock to whom I am indebted for the photographic plate of these moths, as well as many other favors and encouragement.

Fig. 7. Pseudohazis hera marcata aberration gunderi.

The figure is an exact reproduction of this striking abberation. The black markings contrasting with the ground color in white. Main points of distinction from typical marcata are, the basal line and T. P. lines are entirely absent, the white on patagium is absent, as is also the yellow banded abdomen except on the last four segments.

Named in honor of my friend Mr. Jeane D. Gunder of Pasadena, to whom I am indebted for this lovely insect. This is the only moth described in this paper not belonging to the family noctuidae, now known as Phalaenidae.

The specimen is a ♂ marked holotype, coll. Hill, taken on July 3, 1924 in Modoc County, Calif., flying with the normal form, of which I have a small series from the same source.

Fig. 8. "Euxoa" obscura.

Antennae simple, ciliate. Head, collar, patagium and primaries concolorous smoky, shiny grey, reniform, orbicular, basal line and T. P. line faintly traced by darker scales. Secondaries evenly smoky.

Expanse 31 mm.

♂ holotype, ♀ allotype and 10 ♂ and ♀ paratypes in coll. Hill. Type locality, San Diego, Calif., in June.

Fig. 9. Oncocnemis wilsonensis.

The author prefers to withhold the description of this odd noctuid until it is more certainly placed generically. In order to insure type will give it a ms. specific name until more and perfect specimens are taken. I have since learned that Mr. E. Piazza has a perfect specimen of this species.

Fig. 10. Litoprosopus coachella—Hill.

Described by the author in the Ent. News, April, 1921, pp. 105 and herewith figured for the first time.

A male paratype was deposited in coll. of Dr. Wm. Barnes in appreciation of courtesies shown. There were four specimens, all males before the author at time of description, not two as it stated in error in publication noted above, all specimens having been taken in June at Palm Springs, Calif., by E. Piazza and K. Coolidge who kindly presented me with two of them.

I recently saw two specimens of this species in coll. of E. D. Jones, taken on his front porch here in Glendale, Calif., and Mr. Piazza took another in San Diego, June. This specimen now is in coll. of Mr. W. S. Wright, so that there are now seven specimens known of this distinct species. Dr. Dyar states it probably feeds on palm.

11. Chamoclea benjamini, Hill.

Bulletin California Academy Sciences, September-October, 1924, pp. 158.

This is a figure of the above as noted therein.

Fig. 12. Mycterophora geometriformis.

Antennae finely bipectinate. A quadrate patch of light yellow at apex which joins a broad band of same color along costal margin extending to base.

T. A. and T. P. lines black, parallel and extending across secondaries. The wings are sprinkled with a brown scale.

Expanse 19 mm.

Described from three specimens, ♂ holotype, ♀ allotype and one ♂ paratype in coll. of author. All taken at Mt. Lowe, 5,000 feet elevation, Los Angeles County, Calif., at light.

This insect has all the habitus of a geometer, but according to Dr. Dyar is placed in the Noctuidae, on the basis of its venation.

Fig. 13. Schima coolidgei.

Antennae ciliate. Head, thorax and abdomen, white. Primaries white with maculation in yellow brown. There is a quadrate spot be-

fore apex; basal line and T. P. line defined by brown scaling. Reniform reduced to a small black dot.

Secondaries creamy white, with band before margin of a smoky brown. ♂ holotype and two ♂ paratypes in coll. Hill. Holotype, Jacunba, San Diego County, Cal., Sept.; paratypes, Victorville, Cal., Sept.

Expanse 24 mm.

Named for Mr. Karl R. Coolidge to whom I am indebted for two of the above specimens.

Fig. 14. Plusiodonta compressipalis suffusa. form nov.

A single male specimen holotype ♂ before me from the Baboquararia Mountains of Southern Arizona in July, differs from the normal form so markedly in color and general habitus, that it is deserving of a form name. All the maculation can be traced somewhat similiar to compressipalis, but of a purple shade. The basal line is sharply defined and differs in its course from the normal species.

Secondaries smoky. Expanse 22 mm.

There is no trace of golden markings as in the normal form.

Fig. 15. Schinia silveroides.

Antennae ciliate. Head, thorax and abdomen grey white, shiny; primaries silver grey. All the maculation obsolete except a T. P. line straightly oblique, defined by a white shading of scales.

Secondaries shiny, greyed white. ♂ holotype, ♀ allotype in coll. Hill taken at Uvalda, Texas, March 9, 1923. (E. Piazza.)

Expanse 26 mm.

Fig. 16. Perographa palomarensis.

Antennae bipectinate. Head, thorax, abdomen and primaries dull mouse-grey, heavily scaled. Orbicular, reniform and median area a rich chocolate brown, the veins for 2 mm. of their length of same color, from median area outwardly. Secondaries even smoky.

Expanse 36 mm.

This beautiful species, a unique in the author's collection is designated ♂ holotype and was taken in February at Nellie, San Diego County, Calif., at the base of Palomar Mountain.

Fig. 17. Cirphis februalis.

Antennae ciliate. Head, thorax, abdomen and primaries concolorous sand yellow. The ordinary marks obsolete. Median vein sharply defined by black scales from base to outer margin, with black dot before branch of veins II and III. Veination along outer margin smoky. Scaled.

Secondaries shiny white, slightly greyed, on outer margin spotty.

Expanse 35 mm. Described from 7 specimens ♂ holotype, ♀ allotypes, 5 paratype ♂ and ♀s in coll. Hill taken in February at San Diego, Calif.

The author is indebted to Dr. Harrison G. Dyar for the generic determinations of the majority of the above new species and determining four of the species as new, also the loan of specimens, the following being returned to him for deposit in U. S. National Museum as paratypes so labelled:

Stiria dyari, Namangana funeralis, Euxoa obscura and Cirphis februalis. Paratypes of the remainder in case of sufficient material will be placed in the National Museum.

Also paratypes of all the above where possible will be deposited in collection of Dr. Wm. Barnes of Decatur, Illinois, a list of these to be published at an early date, in appreciation of courtesies shown.

This is the first of a series of papers on the Noctuid Moths of the Southwest, which the author hopes to publish from time to time in this publication.

BULLETIN of the SOUTHERN CALIFORNIA
ACADEMY of SCIENCES

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Publications of the

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Bulletin of the

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DR. JOHN A. COMSTOCK, *Secretary*

Southern California Academy of Sciences, Southwest Museum
Los Angeles, California.

Bulletin, Southern California Academy of Sciences

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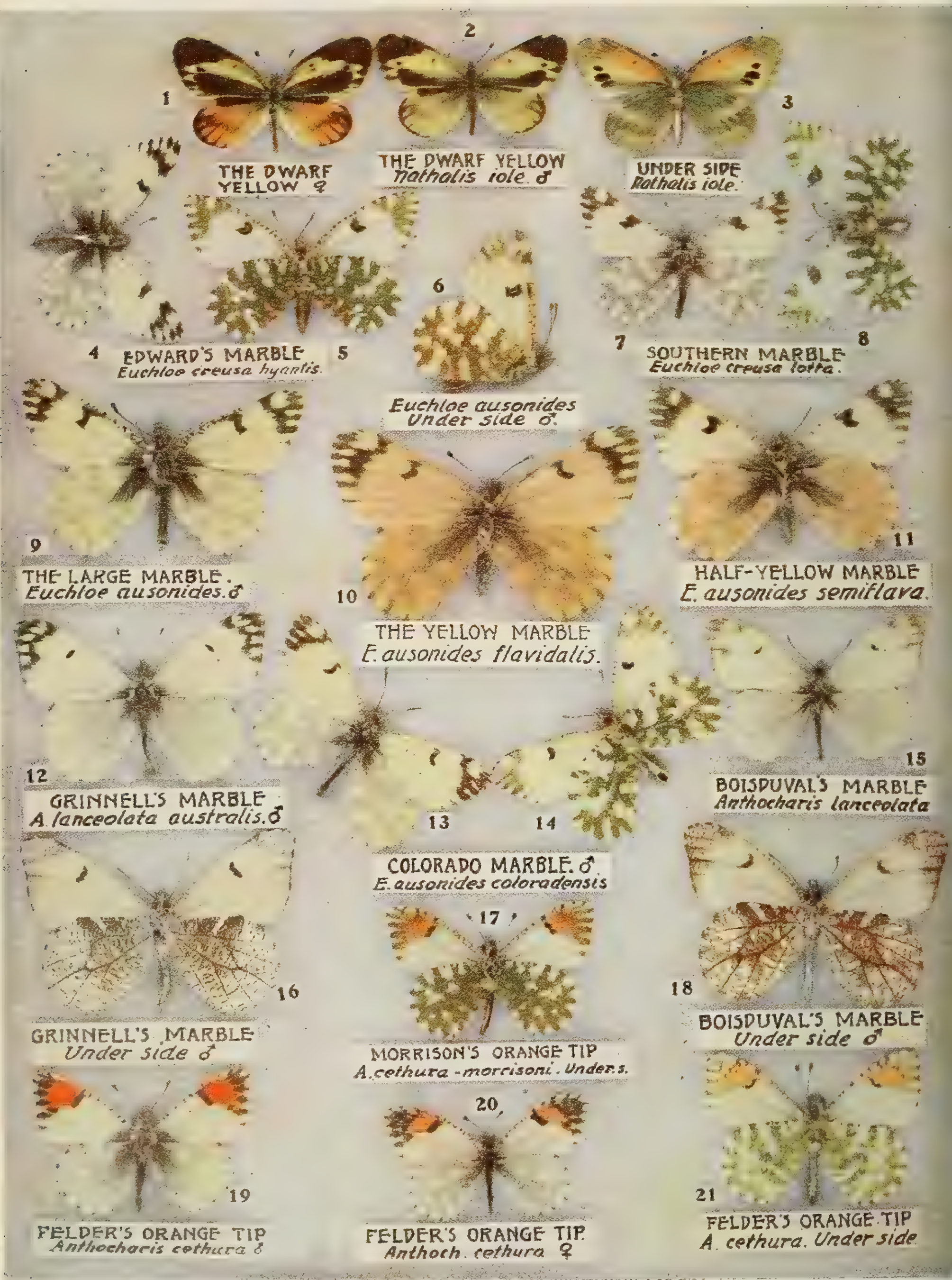

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STUDIES IN PACIFIC COAST LEPIDOPTERA

(Continued)

JOHN A. COMSTOCK, M. A., M. D., F. E. S.

A New Variety and Two New Aberrant Forms of California Butterflies

Eurymus behri Edw. form **canescens.** var. nov.

Most of the collectors and students of West American butterflies have long been familiar with the fact that the female of Eurymus behri Edw. occurs in two forms, a yellow and a white. This follows a rule occuring in many members of the genus, in which albinism of this sex is common. The albinic females of our more common sulphurs have received names, but the white female of E. behri has thus far escaped a designation.

I propose for this form the name **canescens** and fix as the type the specimen shown on plate XVI, figure 4 of my forthcoming "Butterflies of California." This plate will be subsequently shown in the "Bulletin."

The form differs in no particular from typical E. behri ♀ except that the ground color is white instead of yellow or greenish yellow as in the typical examples.

Type, Tioga Pass, Yosemite, Calif., Aug. 4, 1922.

Six paratypes. Same place and date. In the collection of the Southwest Museum.

Danaus berenice aberration **kerri,** aber. nov.

An interesting aberrant example has come to us through the courtesy of Mr. Laurance T. Kerr of Orange, Cal., which I take pleasure in naming after him. It is a male, somewhat dwarfed but normally formed, and differs from D. berenice in the fact that all of the white spots occuring in both the primaries and secondaries of the typical insect are totally suppressed on both upper and under surfaces of the wings. A colored reproduction of the type will be shown on Plate XVII, figure 6, thus rendering a detailed description unnecessary.

Type. ♂ Taken at Blythe, Calif., Oct. 28, 1921, in the collection of the Southwest Museum.

Argynnis apacheana, Skinner. **aberration hermosa,** aber. nov.

A remarkable aberration of this beautiful fritillary was captured by the writer in Inyo County, California, along with numerous examples of the typical insect.

This unique specimen is a male, and may be described as follows:

Ground color, and all markings as in typical male **apacheana,** except as follows:

Primaries, superior surface.

The submarginal row of sagittal spots slightly heavier and tending to join the marginal line. The basal and discal portions solid black, except for three brown spots as follows: one oblongate bar across the centre of cell, one small triangular spot beyond outer edge of cell; one oval spot below first median nervule. A very slight brown powdering suffuses the inner portion of basal area.

Secondaries, superior surface.

No variation from the normal maculation of the species.

Inferior surface, primaries and secondaries.

The butterfly does not differ on the under surface, from the normal markings.

Expanse: Two and five-eights inches (67 mm.).

Type: One male, Round Valley, Inyo County, California, July 30, 1922. In the collection of the author, Southwest Museum, Los Angeles.

I venture to describe this interesting aberration because of its suggestive approach toward the eastern **A. diana.** It is possible that we may have here a hint as to the phylogenetic affinities of the species. This will be subsequently illustrated in colors on plate 23 in our forthcoming "Butterflies of California," figure 4.

BUTTERFLIES OF CALIFORNIA

DR. JOHN A. COMSTOCK

(Continued)

GENUS EUCHLOE Hubner

The Marbles

The Colorado Marble (Euchloe ausonides coloradensis Hy. Edw.) represents the alpine race of the Large Marble, and is distinquished from it principally by its somewhat smaller size, and the reduction of the spot at end of cell to a narrow dash. The marbling on underside of secondaries usually contains less of the yellow scaling.

GENUS ANTHOCHARIS Bdv.

The Marbles and Orange Tips

Boisduval's Marble. (Anthocharis lanceolata Bdv.) is one of our mountain dwellers, occuring at suitable elevations throughout the Sierras. A southern race, **Grinnell's Marble,** extends the range into our southern Sierras, and differs from the typical form only in the greyish shade of the marbling on under surface of wings, crescentic shape of the discal spot, and the darker markings in the apical region of the primaries. In the lower transitional zone one may find the species in March and April, but with an increase in altitude, there is a corresponding retardation in its emergence. The larvae feed on the tower and hedge mustards. The species are figured on plate X.

Felder's Orange-Tip (Anthocharis cethura Feld.) is one of our rarest orange-tips, occuring very sparingly throughout Southern California. Its favorite haunts are barren mesas and the summits of small desert hills. Like all of the orange-tips, it is an early spring form. Nothing is known of the early stages. Colored illustrations of this and also the following variety, are shown on plate X, in this issue of the Bulletin.

Morrison's Orange-tip. (Anthocharis cethura morrisoni, Edw.) is a form of the above in which the green mottling of the under surface is much darker and heavier. Figure 17 of plate X clearly illustrates this rare insect.

Two other varieties of this delicate and beautiful butterfly have received names. **The Desert Orange-tip** (A. cethura deserti. W. G. Wright) is an exceedingly rare form found on our southern deserts. It may be distinguished by the reduction of the orange spot on primaries, as may be seen by reference to plate XI, figures 1 and 3. This plate will appear in the next issue of the Bulletin. **The Tinted Desert Orange-tip** (A. cethura caliente, W. G. Wright) is also a desert form in which a yellow suffusion covers both wings. It is by far the rarest member of the group. See plate XI, figure 2.

THE POTENTILLAS OF SOUTHERN CALIFORNIA

—— By ——

PHILIP A. MUNZ* and IVAN M. JOHNSTON†

The Potentillas of Southern California have never been the subject of a special paper. The student interested in the species found in Southern California has had to rely on accounts of them given in the Botany of California by Brewer and Watson, which is quite out of date, or on those in the several generic monographs which vary widely in scope and specific concept. In the present paper an attempt has been made to supply an account of the local species of *Potentilla*, this study being based on field work and careful consideration of a large amount of herbarium material. Although we have treated only those species which grow in the eight southernmost counties of California, repeated consideration and study have been given to the related extralimital species and it is hoped that a practical and logical classification has been obtained.

The genus *Potentilla* is here taken in its broadest sense, including not only such genera as *Drymocallis*, *Stellariopsis*, and *Argentina*, which are maintained by Rydberg, but even *Horkelia*, *Ivesia*, and *Sibbaldia*, generic segregates kept up by Gray, Watson and Wolf. Our study of the group convinces us that there is no intermediate stand; either Potentilla should be completely broken up into small genera, or it should be accepted in the inclusive sense once argued for by Greene, Pittonia 1:95-106, 1887. The inclusive genus, well defined as it is by technical details and characterized even to the amateur by its readily recognized habit, we feel is preferable to a galaxy of small and intergrading technical genera, hence we are content to follow such authority as Bentham and Hooker, Gen. Pl. 1:620 (1865), Hall, Univ. Cal. Pub. Bot. 1:86. (1902), and Jepson, Fl. West. Mid. Cal., 208. (1911), thus defining *Potentilla* in its broadest sense.

During the preparation of this paper, we have had opportunity of studying Southern California Potentillas in most of the important local as well as national herbaria. The California collections examined are those at Pomona College (Po), University of California (UC), and Stanford University (St), and the private herbaria of Mr. Frank Peirson of Pasadena (FP) and Dr. A. Davidson of Los Angeles (D). The material at the Gray Herbarium (G), New York Botanical Garden (NY), Philadelphia Academy (Ph), National Museum (US), Field Museum (FM), and Missouri Botanical Garden (Mo) has also been examined. The manuscript was first roughed out in California on the basis of the California material mentioned above, and was subsequently finished at the Gray Herbarium where we had more authentic material at hand and where complete library facilities were obtainable. Later the conclusions arrived at were checked in the other herbaria mentioned. We are very glad to acknowledge our gratitude to the curators of the various herbaria visited for their courtesy and permission to examine specimens under their care. Particular acknowledgment we feel due to Mr. Frank Peirson for valued opinions and suggestions.

In previous papers, which we have written, we have felt a lack in exactness in describing habitats of various species in the groups in which we have worked. The old system of life-zones, valuable as it has been, leaves much to be desired in the amount of information it gives when designating habitat. In casting about for something more suitable for our purposes, we have decided to make use of the classification of plant communities worked out by Clements on pages 114 to 236 of his Plant Indicators (Carnegie Institution Pub. 290. 1920).

*Pomona College, Claremont, Calif. †Gray Herbarium, Harvard University.

The genus *Potentilla* has species growing in almost everyone of the major divisions employed by Clements for Southern California and may serve as a good example of the practicability of using this classification, which can be summarized for our region as follows:

(1) **Desert Scrub Climax (Larrea-Prosopis Formation)**, represented in our California deserts by the **Western Desert Scrub (Larrea-Franseria Association)** with such dominants as: *Larrea divaricata, Franseria dumosa, Parosela spinosa, Fouquiera splendens* and *Olneya tesota.*

(2) **Grassland Climax (Stipa-Bouteloua Formation)**, weakly represented in Southern California by poorly defined relics of **Bunch-Grass Prairie (Agropyron-Stipa Association)**, which is characterized by *Stipa pulchra* and *S. lepida.*

(3) **Sagebrush Climax (Atriplex-Artemisia Formation)**, with two associations in Southern California.

(A) **Basin Sagebrush (Atriplex - Artemisia Association)**, with such dominants as: *Artemisia tridentata, Chrysothamnus nauseosus, Grayia spinosa, Tetradymia spinosa,* and *Gutierrezia Sarothrae.*

(B) **Coastal Sagebrush (Salvia-Artemisia Association)**, with such dominants as *Artemisia californica, Salvia mellifera, S. apiana, S. leucophylla,* and *Eriogonum fasciculatum.*

(4) **Chaparral Climax (Quercus-Ceanothus Formation)**, represented in our region by the **Coastal Chaparral (Adenostoma-Ceanothus Association)** and with such dominants as: *Adenostoma fasciculatum, A. sparsifolium, Ceanothus cuneatus, C. divaricatus, C. verrucosus, Arctostaphylus glauca, Rhamnus crocea, R. californica, Rhus ovata, Photinia arbutifolia,* and *Prunus illicifolia.*

(5) **Woodland Climax (Pinus-Juniperus Formation)**, in Southern California divided into:

(A) **Pinon-cedar Woodland (Pinus-Juniperus Association)**, the association of *Juniperus utahensis* and *Pinus monophylla* occurring in our mountains in the eastern part of the California deserts.

(B) **Pine-oak Woodland (Pinus-Quercus Association)**, characterized by *Pinus Sabiniana, Quercus Wislizenii, Juniperus californica, Pinus monophylla,* and *Yucca brevifolia.*

(6) **Montane Forest Climax (Pinus - Pseudotsuga Formation)** with one association in Southern California, the **Sierran Montane Forest (Pinus Association)**, having such dominants as: *Pinus ponderosa, P. Lambertiana, P. Coulteri, Abies concolor, Pseudotsuga macrocarpa,* and *Libocedrus decurrens.*

(7) **Subalpine Forest Climax (Picea-Abies Formation)** represented by the **Sierran Subalpine Forest (Pinus-Tsuga Association)** and with *Pinus Murrayana* and *P. flexilis* dominant.

(8) **Alpine Meadow Climax (Carex-Poa Formation)**, the Californian representation of which, the **Sierran Alpine Meadow (Carex-Agrostis Association)** is barely suggested on our highest Southern California peaks by such species as: *Ranunculus Eschscholtzii, Festuca supina, Juncus Parryi,* and *Oxyria digyna.*

In general, it can be said that the first of the divisions treated above is about the same as the Lower Sonoran Zone; the second, third, fourth, and fifth together are comparable to the Upper Sonoran, the sixth to the Transition, the seventh to the Hudsonian-Canadian, and the eighth to the Arctic-Alpine.

KEY TO SOUTHERN CALIFORNIA SPECIES OF POTENTILLA

Annuals or biennials; weedy plants of wet soils; inflorescence usually leafy and many flowered.

Petals about as long as the sepals; calyx more or less enlarged in fruit............................9. *P. norvegica* var. *hirsuta*.
Petals about half as long as sepals; calyx scarcely enlarged in fruit.

Stems erect or strictly ascending; herbage dull green, somewhat glandular; leaflets of cauline leaves cuneate-obovate...
....8. *P. biennis*.
Stems spreading and diffusely branched from base; herbage light green, not glandular; leaflets of cauline leaves cuneate-oblong.......................................10. *P. millegrana*.

Perennials; inflorescence usually inconspicuously leafy.

Basal leaves palmate or practically so.

Lower leaves 3-foliolate; stamens generally 5..17. *P. Sibbaldi*.
Lower leaves 5- to 7-foliolate; stamens generally 20.

Stems prostrate; leaves subpalmate, with a suggestion of of a pinnate condition; pubescence silky, tawny........
......................................12. *P. Wheeleri*.
Stems ascending, at least toward the apex; leaves truly palmate; pubescence rarely silky, not tawny...........
....11. *P. gracilis*.

Basal leaves evidently pinnate.

Flowers solitary on naked, axillary peduncles; spreading by stolons.

Achenes corky, conspicuously dorsally grooved; pubescence more or less lustrous...............15. *P. Anserina*.
Achenes firm, rounded dorsally, not grooved; pubescence usually dull.......................16. *P. pacifica*.

Flowers cymose; stems not stoloniferous.

Leaflets very numerous (20 or more pairs), densely imbricated, conspicuously silvery-silky.

Inflorescence congested; pistils about 6; stems loosely decumbent..................5. *P. argyrocoma*.
Inflorescence diffusely paniculate; pistil one; stems suberect. ....7. *P. santolinoides*.

Leaflets less than 15 pairs, usually not densely imbricated, and not silvery-silky, though occasionally white-tomentose.

Outer filaments conspicuously dilated.

Leaflets flabellate-dissected; stems widely spreading; petals about 2 mm. long......1. *P. Wilderae*.
Leaflets more or less toothed; stems erect to ascending; petals mostly over 4 mm. long.

Leaflets of basal leaves few, 1-3 pairs; terminal leaflet petiolulate, not lobed; petals broadly obovate or orbicular...4. *P. truncata*.
Leaflets of basal leaves 5-many pairs; terminal leaflet lobed; petals oblong-spatulate.

Herbage dark green, oily, strongly glandular; leaflets over 1 cm. long; valley plants ....2. *P. cuneata.*
Herbage light green to canescent, not oily, sparsely if at all glandular; leaflets mostly less than 1 cm. long; montane plants ....3. *P. Bolanderi.*

Outer filaments not conspicuously dilated.

Style not inserted near the base of the achene.

Leaflets bi- or tri-lobed, in about 7 crowded pairs; stamens separated from the receptacle by an open space................6. *P. callida.*

Leaflets not bi- or tri-lobed, not crowded.

Petals elliptic-oblong, 2-3 mm. long; herbage glandular; of desert mountains.... ....13. *P. saxosa.*
Petals broadly obcordate, 5-6 mm. long; herbage not glandular; of coastal swamps ....14. *P. multijuga.*

Style inserted near the base of the achene.

Styles fusiform, about twice as long as mature achenes; petals not erect in anthesis; leaflets usually merely dentate.

Stems and leaves commonly viscid-glandular and strongly pubescent; leaves dark green above, evidently lighter below; stems generally reddish. 18. *P. glandulosa.*
Stems and leaves glabrate or inconspicuously glandular, not viscid; leaves light green, scarcely bicolored; stems light green...............19. *P. Hanseni.*

Styles almost filiform, about 3 times the length of the mature achenes; petals erect in anthesis; leaflets generally cuneate-flabelliform....................20. *P. cuneifolla.*

TREATMENT OF SPECIES

1. **Potentilla Wilderae** (Parish) n. comb.

Horkelia Wilderae Parish, Bot. Gaz. 38:460. 1904. Rydberg, No. Am. Fl. 22:272. 1908. Parish, Pl. World 20:220. 1917. Davidson & Moxley, Fl. So. Calif., 174. 1923.

Pale green perennial from perpendicular root, with several caespitose widely spreading slender stems, 1-3 dm. high, finely glandular-pubescent throughout, diffusely branched above; stipules of lower leaves 1-1.5 cm. long, with free tips ca. 3 mm. long, lanceolate, sometimes toothed; upper stipules lance-ovate, 3-8 mm. long; basal leaves pinnate, 5-10 cm. long; petioles 1-4 cm. long; leaflets 13-21, 5-10 mm. long, cuneate, deeply incised into few oblong lobes; cauline leaves much reduced, the uppermost unifoliolate, dissected; flowers numerous on slender recurving pedicels 5-14 mm. long; hypanthium cupulate ca. 2 mm. in diameter, glandular-puberulent and somewhat ciliolate; bractlets oblong, 0.7-1 mm. long, becoming reflexed; sepals triangular-lanceolate, erect, ca. 2 mm. long; "petals obovate, white, about equaling the sepals;" achenes several, only 1 or 2 maturing and these ca. 1.8 mm. long, subapically bearing a scarcely thickened smooth style; filaments 10, deltoid, borne on hypanthium somewhat above base of receptacle; receptacle villous.

Distribution very local; known only from the vicinity of the type locality, i. e., the highest point (7,500-7,600 ft. alt.) on the trail from Barton Flats to the South Fork of the Santa Ana River, San Bernardino Mts. Growing as scattered colonies in small clearings about shrubs and under pines in the Montane Forest Climax. Specimens studied: San Bernardino Co.: Trail to South Fork of Santa Ana River, "elev. 8,000 ft.," June 27, 1904, *Mrs. Wilder 237* (type, St; isotype, U. C.), Aug. 28, 1905, "7,200-8,000 ft.," *Mrs. Wilder 238* (G, Po); above Seven Oaks, 7,500 ft., July 6, *D. L. Crawford* (Po); Barton Flats Trail, 7,600 ft., *F. W. Peirson 3114* (FP, Po), Barton Flats, *Peirson 4277* (FP, Po).

An interesting species far removed geographically from its nearest relative, *P. Parryi* Greene (Pittonia 1:102. 1887), of Amador County, Calif., and distinct from the latter in having much smaller flowers and in lacking a horizontal rootstock.

2. **Potentilla cuneata** (Lindl.) Baill. ex Hook. & Jackson, Ind. Kew. 3:612. 1894.

Horkelia cuneata Lindl., Bot. Reg. 23: sub. pl. 1997. 1837. Rydb., Monog., 132, pl. 66. 1898. No. Am. Fl., 22:275. 1908. *Horkelia californica* var. *cuneata* Gray, Proc. Am. Acad. 6:529. 1865. *Potentilla Lindleyi* Greene. Pittonia 1:101. 1887. *Potentilla puberula* Greene, Pittonia 1:102. 1887. Davidson, List Pls. L. A. Co., 5. 1892. Davidson, Cat. Pls. L. A. Co., 8, 1896. *Horkelia puberula* (Greene) Rydb., Bull. Torrey Club 25:55. 1898. Monog., 131, pl. 65. 1898. No. Am. Fl. 22:275. 1908. Abrams, Fl. L. A., 201. 1904 and 181. 1917. Davidson & Moxley, Fl. So. Calif., 175. 1923. *Horkelia platycalyx* Rydb., Monog., 131, pl. 64. 1898. No. Am. Fl. 22:274. 1908. Abrams, Bull. So. Cal. Acad. 1:88. 1902. Fl. L. A., 201. 1904. Davidson & Moxley, Fl. So. Calif., 174. 1923. *Potentilla multijuga* of Greene, Fl. Fran. 1:66. 1891 and Jepson, Fl. W. Mid. Calif., 209. 1911. *Horkelia capitata* of Torrey, Pac. R. R. Rep. 4:84. 1857. *Horkelia californica* of Wats., Bot. Calif. 1:181, 1876 as to plants of So. Calif. *Potentilla californica* of Davidson, List Pls. L. A. Co., 5, 1892. Cat. Pls. L. A. Co., 8, 1896. McClatchie. Fl. Pasadena, 638. 1895. *Horkelia sericea* of Abrams, Fl. L. A., 201, 1904 and 181. 1917. Rydb., Monog., 128. 1898 for So. Calif. Abrams, Bull. So. Cal. Acad. 1:88. 1902. *Horkelia Kelloggii* of Davidson & Moxley, Fl. So. Calif., 174. 1923. Rydb. No. Am. Fl. 22:273. 1908 for So. Calif.

Perennial with more or less horizontal rootstock, covered with persistent leaf-bases; stems mostly several, ascending, leafy, 2-7 dm. high, strongly glandular-pubescent throughout; lower stipules 1-3 cm. long, pubescent to glandular-pubescent, free portion 5-15 mm. long, lanceolate to lance-linear, usually entire; upper stipules lanceolate to ovate, somewhat smaller, entire or toothed; leaves pinnate, dark green, oily, strongly glandular-pubescent, lower leaves 5-30 cm. long; petioles 2-12 cm.; leaflets 11-25, 5-35 mm. long, cuneate to obovate to orbicular, dentate to almost cleft; terminal leaflet not distinct, but somewhat merged with the nearest ones and appearing lobed; cauline leaves reduced and subsessile; cymes at first congested, but in age loosely and ascendingly branched, rather rigid; pedicels becoming 5-15 mm. long, erect; hypanthium saucer-shaped, 4-7 mm. broad, glandular-pubescent; bractlets 3-4 mm. long, oblong-lanceolate or narrowly ovate; acute, erect; sepals triangular-lanceolate, 4-6 mm. long; petals oblanceolate, rounded at apex, white, a little surpassing sepals; filaments 10, triangular or lance-oblong, borne on hypanthium somewhat above base of villous receptacle; achenes numerous, bearing below apex a subfiliform style 2-3 mm. long.

Entering our region from the north and occurring west of the mountains from Santa Barbara County to San Diego County. Most collected near Santa Barbara and between Los Angeles and San Bernardino. A member of the Coastal Sagebrush Association, growing in gravelly soil below 3,500 ft. alt. in middle stages of the succession. Specimens studied: Santa Barbara Co.: Santa Barbara, *Brandegee in 1888* (FM), *I. E. Diehl 241* (Po), *Brewer 380* (UC), *Rothrock 19* (FM, G, US), *21* (FM); Santa Barbara County, *M. S. Baker in 1895* (UC), *Elmer 3793* (G, St, NY, US), *Wheelock in 1893* (NY); Ellwood, *Eastwood 5, in 1903* (G, NY, UC, US); Dutard's Ranch, *Eastwood in 1896* (G); Blochman's Ranch near Santa Maria, *Eastwood 476* (G, US); Santa Inez Mts., *Dunn in 1891* (UC, US). Ventura County: Ojai Valley, *Hubby in 1896* (UC); Casitas Pass, *Hall 3209* (UC); Ojai, *Peckham in 1866* (US). Los Angeles County: Los Angeles, *Nevin* (UC), *Gambel* (G), *Wallace in 1854* (US); *Hasse in 1888* (FM); Ballona Harbor, *Abrams 1237* (St); Glendale, *Hasse in 1888* (St); Lincoln Park, L. A., *Grant 2202* (St); Garvanza, *Grant in 1902* (UC), *Davidson in 1890* (D); Sierra Santa Monica, *Hasse 3794* (NY); Altadena, *Peirson 362* (FP); Pasadena, *Hall 3750* (FM, Mo, NY, UC), *Grant 599* (St, US), *Abrams 1423* (St); San Gabriel, *Antisell 80* (G), *Bigelow* (G); Glendora, *Grant & Wheeler 599-6258* (FM, G, UC); Pomona Valley, *Barber 146* (UC); North Pomona, *Braunton 205* (UC, US); Claremont, *Robinson 8* (Po), *Baker 4760* (FM, G, NY, Po, St, UC), *Peirson 4278* (FP). San Bernardino Co.: San Antonio Canyon Wash, *Johnston 1892* (NY, Po, St, US); Upland, *Johnston 56* (NY); Deer Canyon Wash, Etiwanda, *Johnston 1887* (NY, Po, St, US); Bloomington, *Hall 169* (UC), *Hall 4963* (FM, G, Mo, Po, NY, St, UC, US); San Bernardino Valley, *Parish 6893* (Po, UC), *Parish 4742* (NY, St), *Parish 279* (FM, G, US), *Parish 3651* (FM, G, UC, US); Colton, *Parish 2036?* (FM, G, NY, Po), *Parish 2208* (NY, US); San Bernardino Mts., *Vasey 164* (US). San Diego Co.: Carlsbad, *Parish 4474* (FM, G, NY, St, US).

The taxonomy and synonymy of this species have been so involved as to be most confusing. We are convinced after careful work on much material that the Southern California plants which have gone commonly under the names of *Horkelia puberula* and *H. platycalyx* have no constant distinguishing features. Certainly corolla-size and depth and width of hypanthium do not distinguish them. Furthermore, our southern plants cannot well be separated from the northern ones, and we must take up for the whole concept, the oldest specific name, *cuneata*. In reducing all the plants of this general type to *cuneata*, we admit frankly that it is difficult to separate them by technical characters from the montaine plants which have been classified as *Cleveland*, *bernardina*, and *Rydbergii*. And yet it is our feeling that there are two general groups: the more oily, glandular, darker green plants of the low altitudes (*cuneata*), and the lighter green, not oily, and scarcely glandular plants of the montane region, which, particularly in San Diego County, run into forms resembling the valley plants. For these montaine plants the oldest specific name is *Bolanderi* and we refer our southern plants to varieties under that species.

3. **Potentilla Bolanderi** (Gray) Greene. Pittonia 1:103. 1887.

Horkelia Bolanderi Gray. Proc. Am. Acad. 7:338. 1868.

Light green to hoary-pubescent perennial from heavy perpendicular root with branching crown and 1-several erect or ascending stems 0.5-5. dm. high; stipules of lower leaves 10-25 mm. long, free tips 5-12 mm. long, linear, mostly entire; upper stipules 8-12 mm. long, lance-ovate, generally dentate; leaves pinnate, mostly clustered at base of plant; lower leaves 3-15 cm. long; petioles 1-6 cm.; leaflets 11-19, 3-10 (15) mm. long, cuneate to cuneate-obovate to suborbicular, toothed or

cleft at apex; cauline leaves reduced, uppermost sometimes unifoliate, dissected; inflorescence loosely but rigidly branched, bearing more or less congested few-flowered cymules; pedicels erect, 2-5 mm. long; hypanthium cupulate, 2.5-4 mm. broad; sepals lanceolate, 3-4 mm. long, erect; bractlets lanceolate, 1-2 mm. long; petals white, oblanceolate, rounded at apex, slightly exceeding sepals; filaments 10, triangular, borne on hypanthium above somewhat villous receptacle, filiform, almost 2 mm. long; achenes numerous.

Our southern montane plants are very near *Potentilla Bolanderi* of Central California and apparently deserve only varietal rank. They are distinguished from the typical form by less shaggy pubescence, perhaps more cupulate hypanthium, and widely separated range. They fall readily into two varieties:

Herbage canescent, not at all glandular...*P. Bolanderi* var. *Parryi.*

Herbage merely pubescent, sparsely glandular. *P. Bolanderi* var. *Clevelandi.*

3a. **Potentilla Bolanderi** var. **Parryi** (Wats.) n. comb.

Horkelia Bolanderi var. *Parryi* Wats. Bot. Calif. 1:182. 1876. Davidson, Cat. Pls. L. A. Co., 8. 1896. *Horkelia Parryi* (Wats.) Rydb. Monog. 1:129. pl. 62.1898. Davidson, Erythea 2:64.1894. *Horkelia bernardina* Rydb. No. Am. Fl. 22:273.1908. Parish, Pl. World 20:217. 1917. Davidson Moxley Fl. So. Calif., 174. 1923. *Horkelia Rydbergii* Elmer, Bot. Gaz. 39:50.1905. Rydb. No. Am. Fl. 22:273.1908. Davidson & Moxley, Fl. So. Calif., 173.1923.

Not *Horkelia Parryi* Greene, Bull. Calif. Acad. 2:416.1887 nor *Potentilla Parryi* Greene, Pittonia 1:102. 1887.

Herbage canescent, conspicuously strigose, glandless.

Growing in moist soil about meadows, under pines, and along banks of streams at elevations from 4000 to 9500 ft., in the mountains from Ventura to San Bernardino Counties. Type locality, San Bernardino Mts. A plant of the Montane Forest Climax. We have seen the following material. Ventura County: "Santa Barbara," *Rothrock 21. July 1875* (Yale) probably Mt. Pinos (See *Rothrock 210* under *P. santolinoides);* Cuddy Valley, Mt. Pinos, *Hall 6353* (Po); Frazier Mt., *Hall 6610* (UC); *Coville & Funston 1198* (US); Lockwood Valley, *Dudley & Lamb 4674* (Po, St); Griffins, *Elmer 3971* (NY, St). Los Angeles Co.: Pine Flats, San Gabriel Mts., *Peirson 2448* (FP, Po); *Kessler in 1921* (D); Mescal Creek, San Gabriel Mts., *Munz 7694* (Po), *Peirson 4026* (FP); Big Rock, *Davidson in 1893* (D). San Bernardino Co.: Holcomb Valley, *Pierce in 1922* (Po); Head of Devil's Canyon, *Parish 2368* (NY); *in 1900* (St); Little Green Valley, *G. R. Hall 6* (St, UC); Doble, Bear Valley, *Parish 10888* (G, NY, St); Bear Valley, *Hall 7560* (NY, UC), *Jones 6299* (Po); *Abrams 2837* (FM, G, NY, St), *Peirson 1966* (FP); Strawberry Peak, *Abrams 2000* (NY, Po, St); Mohave River, *Palmer in 1876* (G); Round Valley above Barton Flats, *Wilder 416* (Po); South Fork of Santa Ana, *Munz 6256* (Po); *Peirson 3286* (FP), *J. & H. W. Grinnell 221* (US); Upper Santa Ana Canyon, *Hall 7540* (NY, St, UC), *7541* (NY, Po, UC); Big Meadows of Santa Ana, *Munz 6132* (NY, Po); Grayback, *Lemmon in 1879* (FM, G); Between Vivian and High Creeks, *Munz 7598* (NY, Po), *Peirson 3976* (FP); High Creek, *Crawford 892* (Po); Seeley Flat, *Parish 2368* (FM, UC); San Bernardino Mts., *Parish 3706* (G, UC), *Hall 1300* (NY, UC). *Blasdale in 1891* (UC), *Parry in 1875* (G), *Nevin in 1880* (G), *S. B. & W. F. Parish 607* (St, US); So. Calif., *Parry & Lemmon 103* (FM).

Plants west of Cajon Pass are rather more canescent than those of the San Bernardino Mts. and were described by Elmer as *Horkelia Rydbergii*, but we find insufficient grounds for maintaining this even as a variety distinct from *Parryi*.

3b. **Potentilla Bolanderi var Clevelandi** (Greene) n. comb.

Potentilla Clevelandi Greene, Pittonia 1:102. 1887. Hall, Univ. Calif. Pub. Bot. 1:187.1902. *Horkelia Clevelandi* (Greene) Rydb., Bull. Torrey Club 25:54.1898. Rydb., No. Am. Fl. 22:273.1908. Davidson & Moxley, Fl. So. Calif. 174.1923. *Horkelia californica* of Brandegee, Zoe 4:204.1893.

Herbage light green, more or less pubescent, sparsely glandular.

Ranging from the San Jacinto Mts. southward to the San Pedro Martirs in northern Lower California. Fairly frequent in situations similar to those of var. *Parryi.* Commonly forming dense matted colonies in the Montane Forest Climax at elevations from 4200 to 7200 ft. Type locality, Laguna Mts., San Diego Co. The material listed below has been studied. Riverside Co.: San Jacinto Mts., *S. B. & W. F. Parish 1107* (FM), *Orcutt in 1890* (US), *Orcutt 2104* (UC), *Anthony in 1895* (UC); Strawberry Valley, San Jacinto Mts., *Hall 2291*, (NY, St, UC), *648* (UC), *Hasse 5650* (NY), *F. Grinnell Jr. in 1908* (Po, St); Idyllwild, *Spencer 1202, June 15, 1921* (NY, Po), *1202, June 19, 1919* (G, Po), *2199* (Po); Keen Camp, *Munz 5766* (Po); Tahquitz Valley, *Munz 6011* (Po); *Hall 738* (US), San Diego Co.; *Mrs. Gregory in 1891* (UC); Palomar, *Brandegee in 1893* (UC), *Hall 1966* (UC), *Peirson 4780* (FP), *Stokes in 1895* (St), *Chandler 5392* (NY, UC); Noble Mine, *Chandler 5490* (NY, UC), *Parish 4529* (NY, St); Cuyamaca, *T. S. Brandegee in 1894* (UC); *Abrams 3922* (FM, G, NY, Po, St, UC, US); Laguna Mts., *T. S. Brandegee in 1904* (UC); *Eastwood 9219* (G), *Spencer 951* (G), *Cleveland in 1886* (UC), *Mearns 3523* (US), Lower California: Hansens, *Orcutt in 1883* (US), *Orcutt 905* (UC); Cantillas Mts., *Orcutt in 1883* (G); San Pedro Martir, *T. S. Brandegee in 1893* (UC, US).

4. **Potentilla truncata** (Rydb.) n. comb.

Horkelia truncata Rydb. No. Am. Fl. 22:274. 1908. Davidson & Moxley, Fl. So. Calif., 174.1923.

Yellowish-green perennial from a short root; glandular-pubescent throughout; stems several, erect, leafy, 3-7 dm. high, branching only near the top; lower stipules 1-2 cm. long, over half free, more or less cleft; cauline mostly ovate, cleft or toothed, uppermost smaller, sometimes entire, ovate to lanceolate; leaves pinnate; lower ones few, 6-15 cm. long; petioles 3-5 cm.; leaflets 5-9, oblong to obovate-cuneate, lateral ones 1-3 cm. long, sometimes rather finely dentate except for the coarser teeth at the end; terminal leaflet larger, petiolulate, not lobed; cauline leaves somewhat reduced, the uppermost 1- to 3- foliolate, leaflets narrower; cyme few flowered, with a few strictly ascending branches bearing somewhat congested floral clusters; pedicels becoming 5-30 mm. long, ascending or erect, glandular-pubescent; hypanthium saucer-shaped, ca. 5 mm. broad; sepals triangular, 4-5 mm. long, glandular-pubescent; bractlets ovate, acute, ca. 4 mm. long; petals white, orbicular, clawed, ca. 5 mm. in diameter; filaments 10, outer very broadly triangular, inner ones triangular-ovate, borne on hypanthium somewhat above base of glabrate receptacle; achenes numerous, bearing just below apex a slender style 2-3 mm. long.

A little known but distinct species, apparently from the Coastal Chaparral of eastern San Diego County and northern Lower California. We know of the following collections: San Diego Co.: Mesa Grande, *Spencer 1160, June 1, 1919* (G, NY, Po); near Ramona, *Chandler 5321* (NY). Lower California: Guadalupe Mine, *Orcutt in 1883* (FM, NY); Guadalupe Mts., *Orcutt 840* (G).

5. **Potentilla argyrocoma** (Rydb.) n. comb.

Horkelia argyrocoma Rydb., Monog., 144, pl. 84.1898. *Ivesia argyrocoma* Rydb. No. Am. Fl. 22:284.1908. Parish, Pl. World 20:218. 1917. Davidson & Moxley, Fl. So. Calif., 175.1923. *Ivesia unguiculata* of Wats., Bot. Calif., 2:444.1880.

Perennial, silvery-silky throughout; caudex short, with yellowish or brownish, hairy, persistent leaf-bases; stems several, generally with reddish tinge, 1-3 dm. high, spreading, leafy, branching freely; basal stipules ca. 1 cm. long, the free portion 2-3 mm. long, subulate; cauline stipules 4-10 mm. long, lanceolate to lance-ovate, often toothed; leaves with very numerous, closely imbricate leaflets, so as to be almost vermiform; lower leaves numerous, 3:10 cm. long; petioles 1-3 cm. long, with wide-spreading silvery hair; leaflets 1-3 mm. long, divided almost to base into 2 ovate lobes; upper leaves gradually reduced and shorter petioled; cymes congested, usually subcapitate; pedicels 1-2 mm. long; hypanthium deeply cupulate, 3-4 mm. broad; sepals oblong or oblong-lanceolate, ca. 3 mm. long; bractlets oblong 2-2.5 mm. long; petals white, clawed, obovate, retuse, 3-4 mm. long; filaments 20, lanceolate or wedge-shaped, borne on the hypanthium somewhat above the hairy receptacle; achenes several, bearing below the apex a subfiliform style ca. 2 mm. long.

Known only from dry meadows and lower slopes of Bear Valley, at 6500 to 6900 ft. alt., where locally frequent in the Montane Forest Climax. Material seen, from San Bernardino Co.: Bear Valley, *S. B. & W. F. Parish 151* (FM, US), *S. B. Parish 3764* (G, UC), *in 1896* (St.), *151* (G), *in 1894* (UC), *3173* (US), *19279* (G, UC), *2362* (FM, NY, UC), *4948* (NY, US). *Pierce in 1922* (Po), *Harwood 4361* (Po), *Munz 5650* (Po), *Jones 6298* (Po, US), *Abrams 2903* (NY, St.), *Parry & Lemmon 104* (G, Mo), *Leiberg 3306* (US); no locality given, *Parry & Lemmon in 1876* (FM, G, NY).

6. **Potentilla callida** Hall. Univ. Calif. Pub. Bot. 1:86.1902.

Ivesia callida (Hall) Rydb. No. Am. Fl. 22:286.1908. Davidson & Moxley, Fl. So. Calif., 175.1923.

Perennial, villous throughout, glandular above; root ca. 2 mm. thick, somewhat woody; stems several, slender, simple, erect or ascending, 3-5 cm. high; stipules ca. 1 cm. long, the free portion lanceolate, 2-3 mm. long, entire or toothed; leaves villous, pinnate, mostly basal; lower leaves 2-3 cm. long; petioles 0.5-1 cm. long; leaflets in ca. 7 pairs, crowded, 3-4 mm. long, divided to base into 2 or 3 oval segments; upper leaves reduced, with 1-5 leaflets; "flowers sometimes solitary on ends of stems, but usually 3 to 6 in a simple raceme"; pedicels slender, 4-10 mm. long; hypanthium saucer-shaped, 3-5 mm. wide, glandular-villous; sepals lance-ovate, ca. 2.5 mm. long; bractlets narrow, 1:5 mm. long; "petals white, oblong, obtuse or acutish, narrowed at base but not clawed, a little longer than the calyx" (ca. 3 mm. long); stamens ca. 20; filaments filiform; receptacle hairy; "pistils several, styles laterally attached slightly longer than the glabrous achenes."

Known only from Tahquitz Peak, San Jacinto Mts., where it grows in rock-crevices at about 8000 ft. alt., Montane Forest Climax. Riverside County: Tahquitz Peak, *Hall 2611* (NY, UC), *Kessler in 1921* (D).

7. **Potentilla santolinoides** (Gray) Greene. Pittonia 1:106.1887.

Ivesia santolinoides Gray, Proc. Am. Acad. 6:531.1865. Wats., Bot. Calif. 1:184.1876. Parish, Zoe 4:163. 1894. Pl. World 20:218. 1917. *Stellariopsis santolinoides* (Gray) Rydb., Monog. 155, pl. 95, 1898. No. Am. Fl. 22:292.1908. Davidson & Moxley, Fl. So. Calif., 175. 1923.

Perennial, with deep root and short erect caudex covered with hairy dead leaf-bases; stems several, suberect, slender, 1-4 dm. high, freely branched, almost leafless, with spreading silky hair at very base, otherwise quite glabrous except at the axils; basal stipules 10-15 mm. long, silky, with free linear tips 4-5 mm. long; those of lower cauline leaves ca. 5 mm. long, somewhat ovate, often divided; uppermost reduced; leaves terete, worm-like, white silky, of exceedingly numerous, very closely imbricate leaflets; lower leaves 2-10 cm. long; petioles 0.5-2. cm. long, with spreading silky hair; leaflets divided almost to base into several oval lobes; cauline leaves much reduced and quite sessile; inflorescence diffusely paniculate, open; pedicels very slender, 5-30 mm. long; hypanthium deeply saucer-shaped, 2-3 mm. in diam., glabrous; sepals spreading, deltoid-ovate to ovate-oblong, acute, 1-1.5 mm. long; bractlets ovate, small, very much shorter than the sepals; petals white, orbicular, ca. 2 mm. long; stamens 15, insertion on disk somewhat separated from pistil; filaments filiform; anthers purplish-brown, very broadly obcordate, basifixed, dehiscent by two short lateral slits; pistil one; achene ca. 2 mm. long, mottled, compressed, bearing a filiform style just below apex.

Infrequent, but sometimes locally abundant, on dry gravelly slopes and ridges at altitudes of from 6000 to 9000 ft. Occurring in the Montane Forest Climax in all the mountains from Kern County to Riverside County. Kern Co.: Tehachapi Peak, *Dudley 313* (St, UC, US); top of Shepherds Peak, Bisses Station Tehachapi, *Dudley 410* (St). Ventura Co.: Mt. Pinos, *Munz 7018* (Po), *Rothrock 210*, July 1875 (G, US, Yale), *Dudley & Lamb 4591* (Po, St), *Peirson 3233* (FP, Po), *Abrams & McGregor 252* (St), *Hall 6511* (St, UC); Alamos Mt., *Hall 6705* (UC); Griffins, *Elmer 3814* (G, NY, St, US). Los Angeles Co.: summit of Mt. Waterman, immature specimen, *Peirson in 1921* (FP). San Bernardino Co.: Fish Camp, *Johnston 2880* (Po); Bear Valley, *Parish 3763* (UC, US); Grout Creek, *Parish in 1894, No. 3115* (St, UC, US); Holcomb Valley, *Parish 1819* (G, St, UC, US); Upper Holcomb Creek, *Wilder 758* (Po.) Riverside Co.: Ridge east of Tahquitz Valley, *Jaeger 1043* (Po); Tahquitz Valley, *Spencer 1702* (G).

8. **Potentilla biennis** Greene. Fl. Fran. 1:65.1891.

Potentilla biennis Greene. Rydb. Monog. 44, pl. 9, 1898. No. Am. Fl. 22: 305. 1908. Wolf, Monog. Pot., 400.1908. Parish, Pl. World 20:218.1917. *Tridophyllum bienne* Greene, Leaflets 1:189. 1905. *Potentilla lateriflora* Rydb., Bull. Club 23:261. 1896. *Potentilla millegrana* of Davidson, Muhlenbergia 4:67.1908 and Davidson & Moxley, Fl. So. Calif., 176. 1923. *Potentilla rivalis millegrana* of Coville, Con. U. S. Nat. Herb. 4:96.1893.

Annual or biennial; stems 1 to several, 2-5 dm. high, suberect, finely glandular-pubescent, rather slender, strict, not much branched, leafy to the very summit; stipules not over 1 cm. long, narrowly ovate, entire or toothed, glandular-pubescent; leaves trifoliolate, dull green, glandular-pubescent; lower petioles 2-6 cm. long, glandular-pubescent, upper ones gradually reduced; leaflets cuneate-obovate, at least two-thirds as long as wide, ca. 1-3 cm. long, coarsely dentate; flowers solitary in the axils of the upper leaves, grouped, however, to form leafy racemes; pedicels slender, 5-20 mm. long, ascending; hypanthium saucer-shaped, 3-4 mm. broad; sepals deltoid to ovate-oblong, becoming 3-4 mm. long; bractlets oblong to elliptical, ca. two-thirds length of sepals; petals yellow, inconspicuous, obovate or spatulate, shorter than sepals; stamens 10 on a disk slightly separated from base of receptacle; filaments filiform; pistils numerous; style terminal, fusiform, thickened; achenes pallid.

On exposed banks along streams and lake shores from Inyo Co. to the San Bernardino Mts., at altitudes ranging from 4000 to 7000 ft. Growing in the Piñon-cedar Association of the Woodland Climax and at the lower altitudes in the Montane Forest Climax. Inyo Co.: Panamint Canyon, *Hall & Chandler 7008* (UC); Wood Canyon, Grapevine Mts., *Coville & Funston* 1763 (NY). Kern Co.: Vicinity of Ft. Tejon, *Abrams & McGregor 278* (St); Tehachapi Mts., *Dudley 504* (NY, UC, US); Tehachapi, *Davidson in 1895* (D, UC, reported as *millegrana);* Water Canyon, Tehachapi Mts., *Abrams & McGregor 483* (St, US). Ventura Co.: Mt. Pinos, *Munz 7006* (NY, Po), *Elmer 3805* (G, Mo, UC), *Peirson 3236* (FP, Po). San Bernardino Co.: Upper Santa Ana Canyon, *Hall 7519* (UC), *Peirson 4182* (FP),Bear Valley, *Parish 1816* (FM), *Jones in 1900* (Po), *Davidson 2204* (D), *Abrams 2878* (G, Mo, NK), *S. B. & W. F. Parish 1497* (FM, G, St, US).

9. **Potentilla norvegica** var. **hirsuta** (Michx.) Lehm., Pugill. 9:75.1851.

Potentilla norvegica var. *hirsuta* in Wolf, Monog. Potentilla, 404. 1908. *Potentilla monspeliensis* L., Sp. Pl., 499. 1753. Rydb., Monog., 45, pl. 10. 1898. No. Am. Fl. 22:307. 1908.

Annual or biennial; with one to several stout, leafy, erect or suberect, often reddish, sparsely hirsute stems, 2-6 dm. high, branching above; stipules 1-3 cm. long, ovate, hirsute, usually toothed; leaves palmately 3-foliolate. dark green above, lighter below, hirsute, not glandular; lower ones on hirsute petioles 3-10 cm. long; uppermost subsessile; leaflets 1-7 cm. long, obovate, less than two-thirds as wide as long, with ovate teeth; uppermost leaves with oblanceolate leaflets; flowers in a terminal leafy cyme, this frequently quite congested; pedicels 4-20 mm. long, stiff, pubescent; hypanthium saucer-shaped, becoming 6-8 mm. broad, hirsute; sepals erect, deltoid to ovate-oblong, acute; bractlets oblong or elliptical; petals yellow, broadly obovate or cuneate, about equaling sepals; stamens ca. 20, borne on edge of a disk somewhat above base of receptacle; filaments filiform; pistils numerous; style terminal, fusiform, thickened; achenes tan-colored.

Known in our range only from Cuyamaca Lake, San Diego Co., where it is occasional on moist banks at 4600 ft. alt., in the Montane Forest Climax. San Diego Co.: Cuyamaca Lake, *Munz & Harwood 7189* (NY, Po), *Peirson 4829* (FP, Po).

10. **Potentilla millegrana** Engelm.; Lehm. Delect. Sem. Hort. Hamb. 1849: 11. 1849.

Potentilla millegrana in Rydb., No. Am. Fl. 22:305.1908. Wolf. Monog. Potentilla, 399. 1908. *Potentilla rivalis* var. *millegrana* Wats., Proc. Am. Acad. 8:553. 1873. Bot. Calif., 1:178. 1876. *Potentilla leurocarpa* Rydb., in Britt & Brown, Ill. Fl. 2:212.1897. Rydb., Monog., 43 pl. 8.1898. Parish, Muhlenbergia 9:59. 1913.

Annual or biennial, diffusely branched from base; stems slender, spreading, pubescent, 1-3 dm. long; stipules ovate to lanceolate, pubescent, mostly entire, 3-10 mm. long; leaves trifoliolate, light green, pubescent, not glandular; lower petioles 1-4 cm. long, pubescent; upper reduced; leaflets 5-35 mm. long, cuneate-oblong, with few coarse teeth; flowers axillary, associated to form a leafy, racemiform or dense cymose terminal inflorescence; pedicels 5-30 mm. long, slender, pubescent; hypanhtium saucer-shaped, 3-5 mm. broad; sepals deltoid-ovate to ovate-oblong, abruptly acuminate, pubescent, erect, 2-3 mm. long; bractlets oblong, nearly equaling petals, spreading; petals inconspicu-

ous, shorter than sepals, oblong-ovate, yellowish; stamens ca. 10, on a disk slightly above the base of the receptacle; filaments filiform; pistils numerous; styles apical, fusiform, thickened; achenes tan-colored.

Moist grounds at low altitudes in the Desert Scrub Climax in the southern and eastern parts of our range. To this species we refer the following specimens: Bottom lands of Colorado River, *Parish 8498* (St.) San Bernardino Co.: Needles, *Jones 3842* (FM, NY, Po, UC, US). Imperial Co.:Cameron Lake, *T. S. Brandegee in 1901* (UC); Mountain Springs, *Mearns 3128* (St). Lower California: Seven Wells on Salton River, *Schoenfeldt 2882* (St); Unlucky Lagoon, *Schoenfeldt 2917* (St). A collection by Miss Eastwood (677) on the trail to Manzana Creek, Zaca Lake Forest Reserve in the northwestern part of our region has been referred here; it is a puzzling one and well out of the normal range.

11. **Potentilla gracilis** Dougl.; Hook. Bot. Mag., pl. 2984. 1830.

Potentilla gracilis of Wats., Bot. Calif., 1:179. 1876. Hall, Univ. Calif. Pub. Bot. 1:87.1902. *Potentilla Parishii* Rydb., No. Am. Fl. 22: 313.1908. Davidson & Moxley, Fl. So. Calif., 176.1923. *Potentilla Hallii* Rydb., Bull. Torrey Club 28:176. 1901. Rydb., No. Am. Fl. 22:314. 1908. Parish, Pl. World 20:218.1917. Davidson & Moxley, Fl. So. Calif., 176.1923. *Potentilla lasia* Rydb., No. Am. Fl. 22:314.1908. Parish Pl. World 20:218.1917. Davidson & Moxley, Fl. So. Calif., 176.1923. *Potentilla Elmeri* Rydb., No. Am. Fl., 22:315.1908. Davidson & Moxley, Fl. So. Calif., 176.1923. *Potentilla comosa* Rydb., No. Am. Fl. 22:316.1908. Parish, Pl. World 20:218.1917. Davidson & Moxley, Fl. So. Calif., 176. 1923. *Potentilla Hassei* Rydb., No. Am. Fl. 22:329. 1908. Davidson & Moxley, Fl. So. Calif., 176. 1923. *Potentilla gracilis* var. *fastigiata* of Wats., Bot. Calif., 1:179.1876. Hall, Univ. Calif. Pub. Bot. 1:88.1902. *Potentilla gracilis* var. *rigida* of Wats., l. c. and of Hall, l. c. *Potentilla Nuttallii of Davidson,* Erythea 2:64. 1894. Cat. Pls. L. A. Co., 8. 1896. Muhlenbergia 4:67.1908.

Perennial, with short root; stems somewhat rigid; decumbent to ascending to erect, finely pubescent to villous, not glandular, 1-5 dm. high, branching only above; stipules of basal leaves 1-2 cm. long, glabrous to villous, with free lanceolate, entire tips ca. 5 mm. long; cauline stipules 1-2 cm. long, lanceolate to ovate, glabrous to villous, entire or toothed; leaves palmate, mostly 5-foliolate, the uppermost 3-foliolate or simple; basal leaves several, 4-15 cm. long; petioles 1-12 cm. long, usually villous-hirsute; leaflets 1-5 cm. long, often much greener above than below, finely pubescent to hirsute or silky, oblanceolate to obovate, finely dentate to flabelliform-dissected; cauline leaves few, reduced, uppermost sessile and very small; flowers in more or less loose, corymbose, terminal cymes; hypanthium saucer-shaped, hairy, becoming 4-6 mm. broad; pedicels stiffish, 3-15 mm. long; sepals oblong-lanceolate to ovate-deltoid, acuminate; bractlets oblong, shorter than sepals; petals conspicuous, 5-7 mm. long, yellow, obcordate to obovate-orbicular; stamens usually 20, borne on a disk close to base of receptacle; filaments filiform; pistils numerous; style filiform, terminal.

In and about meadows at from 4,500 to 8,000 ft. alt., usually common in all our mountains in the Montane Forest Climax. Kern Co.: Tehachapi Mts., *Dudley 436* (NY, St, UC, US), *Hasse & Davidson 1706* (D). Ventura Co.: Mt. Pinos, *Elmer 4009*, type collection of *P. Elmeri* (G, Mo, NY, St. UC), *Dudley & Lamb 4482* (Po, St); Head of Piru Creek, *Rothrock 243* (FM); Goodenough Meadow, Mt. Pinos,

Dudley & Lamb 4719 (St); East slope of Mt. Pinos, *Hall 6419* (UC); San Emigdio Potreros, Mt. Pinos, *Hall 6379* (UC); Frazier Mt., *Hall 6613* (UC). Los Angeles Co.: San Antonio Mts., *Hall 232* (UC); Big Rock, *Davidson in 1893* (D, St); Swartout, *Munz 4665* (Po), *Peirson 3165* (FP), *Hall in 1899* (NY). San Bernardino Co.: Bear Valley *Jones in 1900* (Po), *Parish 3252*, type coll. of *P. lasia* (D, NY), *Parish 1817* (FM, US), *Abrams 2828* (G, Mo, NY, Po, St, US). *Pierce in* 1922 (Po), *Edwards in 1917* (Po), *Parish 3152*, type coll. of *P. comosa* (NY); Little Bear Valley, *Chandler in 1897* (UC); Seven Oaks, *Davidson 2237* (D); Hunsaker Flats, *Munz & Johnston 2860* (Po, St); San Bernardino Mts., *W. C. Blasdale* (UC), *Parish 1685* (FM, St. US); Upper Santa Ana Canyon, *Hall 7539* (NY, UC); South Fork, Santa Ana River, *Peirson 1974* (FP), *J. & H. W. Grinnell 252* (US); Mare Flats, *D. L. Crawford, July 6* (Po). Riverside Co.; Tahquitz Valley, *Hall 806* (UC, US), *Munz 5986* (Po), *Hall 2356* (UC), *F. Grinnell, Jr.* (St); Strawberry Valley, *Hall 2296* (Mo, St, NY, UC, US); San Jacinto Mts., *Hasse in 1892, type coll. P. Hassei* (D, NY); Idyllwild, *Spencer 2271* (Po), *1370* (G, NY), *1860* (Po), *2198* (G), *1371* (G,) *Smith 3401* (D); Thomas Valley, *Hall 2184* (UC). San Diego Co.: Palomar, *Hall 1946* (UC), *Peirson 2182* (FP); Doane Valley, *Peirson 4805* (FP); Cuyamaca Lake, *Munz & Harwood 7203* (NY, Po), *Spencer 878a* (NY), *1184* (G), *Dunn in 1899* (UC), *Abrams 3871* (G, Mo, NY, St, UC, US) Cuyamaca Mts., *Palmer 83* (FM, Mo); Laguna Mts., *T. S. Brandegee in 1904* (UC), *Orcutt in 1889* (Mo), *Schoenfeldt 3576* (US); Smith Mt., *McClatchie in 1896* (NY); Descanso, *Parish 4523*, type of *P. Parishii* (NY, St); Mts. E. of San Diego, *Parry in 1850* (NY); "San Diego," *Palmer* (US).

Throughout its range, *Potentilla gracilis* is a variable species and, while our plants deviate somewhat from the typical form, which came from the "banks of the Columbia River," we can find no constant differentiating characters. Rather extended study of the species from the whole western United States has caused us to refer all our Southern California material to *gracilis* proper, although plants from within our region, exhibiting slight variations have been variously named. *P. Parishii* Rydb. has been applied to slender plants of San Diego Co., with leaves pubescent rather than tomentose beneath, green above, and having the pubescence of the stems and petioles appressed. *P. Hallii* Rydb. applies to similar plants of the San Bernardino Mts., but with the pubescence of the stems and petioles spreading, and with many lanceolate teeth to the leaflets. If the teeth to the leaflets are ovate and few, such plants have been called *P. lasia* Rydb. *P. Elmeri* Rydb. applies to Ventura Co. plants with the leaflets rather deeply cleft, green above and white-silky beneath and with pubescence of the stems and petioles appressed. *P. comosa* Rydb. applies to plants of San Bernardino Co., similarly deeply cleft, but with the stems and petioles having a spreading pubescence. Low plants of the San Jacinto Mts., with densely strigose stems and leaves are *P. Hassei* Rydb. The varieties of *P. gracilis*, namely *fastigiata* and *rigida* of Wats. are very ill defined. *Fastigiata* is characterized by its short compact cyme, dense pubescence, and low habit. *Rigida* is tall, stout, and villous, without tomentum. According to Watson the latter is the most common form in California.

12. **Potentilla Wheeleri** Wats. Proc. Am. Acad. 11:148. 1876.

Low perennial, stems several to many, from short caudex, 5-20 cm. long, spreading or prostrate, freely branching, sparsely pubescent to silky-villous; lower stipules ca. 1 cm. long, villous, free portion ca. 5 mm. long, lanceolate, long acuminate; cauline stipules 4-8 mm.

long, pubescent to villous, lanceolate to ovate, generally not toothed; leaves subpalmate; basal leaves many, 1-8 cm. long; petioles 0.5-6 cm., silky-villous to glandular-villous; leaflets 5, silky-villous on both surfaces to glandular-pubescent, cuneate to obovate, with few large terminal broad teeth; stem leaves reduced, becoming trifoliolate or even simple and sessile; flowers in bracteate cymes becoming loosely branched in age; pedicels spreading or recurved, slender, pubescent, 4-16 mm. long; hypanthium saucer-shaped, becoming 4-5 mm. long, strigose; sepals deltoid to ovate-oblong; bractlets oblong; petals yellow, obcordate, 4-5 mm. long, slightly exceeding sepals; stamens 20, borne close to base of receptacle; filaments filiform; pistils numerous; styles filiform.

Represented in our region by two varieties, which can be separated as follows:

Leaves conspicuously silky, scarcely if at all glandular; stems rather rigid..............................*P. Wheeleri* var. *typica.*

Leaves not conspicuously silky, rather green and glandular; stems very slender...........................*P. Wheeleri* var. *rimicola.*

12a. **Potentilla Wheeleri** var. **typica** var. nov.

Potentilla Wheeleri Wats., Proc. Am. Acad. 11:148. 1876. Bot. Calif., 2:444. 1880. Rydb., Monog., 54, pl. 16. 1898. No. Am. Fl. 22:327. 1908. Parish, Pl. World 20:218. 1917. Davidson & Moxley, Fl. So. Calif., 176. 1923. *Potentilla Whelleri* var. *viscidula* Rydb., Bull. Torrey Club 23:429. 1896; Rydb., Monog., 55. 1898; Wolf, Monog. Pot., 518. 1908 as to Calif. plants. *Potentilla viscidula* Rydb., No. Am. Fl. 22:327. 1908 as to Calif. plants. *Potentilla luteosericea* Rydb., Monog., 101. 1908. Rydb., No. Am. Fl. 22:339. 1908. Wolf, Monog. Pot., 208. 1908.

Stems rather rigid; leaves conspicuously silky, slightly or not at all glandular.

In Southern California known only from the San Bernardino Mts., and outside our range from the southern Sierra Nevada and the San Pedro Martirs. At elevations of from 6,500 to 11,500 ft., occurring in meadows and moist places of the Montane and Subalpine Forest Climaxes, and in damp gravel about the summit of San Gorgonio Peak. At this higher altitude it assumes a reduced form which is quite indistinguishable from impoverished plants of dry situations at lower levels. Material studied: So. Calif., *Parry & Lemmon 100* (FM). San Bernardino County: Bear Valley, *Leiberg 3409* (US), *Harwood 4343* (Po). Abrams *2108* (St), Parish *3146* (Mo, St, UC, US), *3773* (G, UC), *2363* (FM, NY, UC), *4944* (NY, St), *Abrams 2746* (Po, St, G, NY, UC, US), *Pierce in 1922* (Po), *Hall 7559* (NY, UC), *Jones in 1900* (P, Mo, US), *Munz 5640* (Po), *Peirson 4606* (FP, St), *Parish 1498* (G, Mo, NY, St, US); Bluff Lake, *Peirson 1978* (FP); Santa Ana River, *Peirson in 1922* (Po); So. Fork, Santa Ana River, *Peirson 3113* (FP); Dry Lake, *Hall 7628* (UC), *Crawford, July 3* (Po), *Peirson 4279* (FP); Mt. San Gorgonio. *Munz 6214* (NY, Po), *Crawford 900* (Po), *Blasdale in 1891* (UC), *Grinnell 24* (UC), *Lemmon* (UC), *Hall 7640* (NY), *7641* (UC), *Peirson 1979* (FP), *Peirson 4180* (FP), *Burlew 3568* (NY), *Abrams & McGregor 752* (NY, St, US), *Wright in 1879* (G), *J. & H. W. Grinnell 274* (US). Lower California: San Pedro Martir. *T. S. Brandegee in 1893*, type of *luteosericea* (NY, UC). Reported from San Antonio Mts. by Davidson & Moxley, Fl. So. Calif., 176. 1923, but we have seen no material.

12b. **Potentilla Wheeleri** var. **rimicola** n. var.

Potentilla Wheeleri of Brandegee, Zoe 4:205. 1893, probably this.

Branches and pedicels very slender; herbage usually green, glandular, with oily pubescence.

Known from the San Jacinto and San Pedro Martir Mts. It apparently inhabits rock-crevices and, with us, occurs in the lower part of the Subalpine Forest Climax at altitudes of 8,000 to 9,000 ft. Type: Dark Canyon, San Jacinto Mts., at 7,900 ft. alt., *Munz & Johnston 8764* (Pomona College Herbarium 43360). Other material from Riverside Co.: Tahquitz Peak, *F. M. Reed 2529* (UC); Mt. San Jacinto, *Kessler, Sept. 1, 1921* (D). Lower California: San Pedro Martir Mts., *T. S. Brandegee in 1892* (UC), *in 1893* (US).

13. **Potentilla saxosa** Lemmon; in Greene, Pittonia 1:171. 1888.

Horkelia saxosa Rydb., Monog., 155. 1898. *Potentilla rosulata* Rydb., Bull. Torrey Club 26:542. 1899. No. Am. Fl. 22:336. 1908. Davidson & Moxley, Fl. So. Calif., 177. 1923. *Potentilla acuminata* Hall, Univ. Calif. Pub. Bot. 1:86. 1902. Rydb., No. Am. Fl. 22:336. 1908. Davidson & Moxley, Fl. So. Calif., 177. 1923.

Low caespitose perennial, usually with thick woody root and caudex; stems few to several, leafy, slender, glandular-pubescent, 3-25 cm. high; lower stipules 5-15 mm. long, densely glandular-pubescent, the free tips lanceolate, 2-4 mm. long; cauline 3-10 mm. long, glandular-pubescent, lanceolate to ovate, subentire; leaves thick to thin in texture, pinnate; basal ones several, 5-15 cm. long; petioles 1-9 cm., finely to heavily glandular-pubescent, or almost oily viscid, 3-15 mm. long, cuneate-obovate to orbicular, strongly toothed to flabellate-dissected; cauline leaves reduced, commonly 3-5 foliolate, uppermost unifoliolate and not greatly reduced; cymes leafy, few or many flowered; pedicels filiform, spreading, becoming 8-15 mm. long; hypanthium plate-shaped, 2-4 mm. broad; sepals ovate or ovate-triangular, acute, spreading, 2-3 mm. long; bractlets oblong, erect, 1.2-2 mm. long; petals oblong, white to ochroleucous, not surpassing sepals; stamens 20 to 40, borne about base of receptacle; filaments filiform; pistils 10 or more; receptacle glabrous or villous at base, achene bearing filiform-subulate style just below apex.

In dry rock-crevices in the lower portions of the Pinyon-cedar Association, along the western borders of the desert at scattered stations from Inyo Co. to Lower California. Inyo Co.: So. of Bishop, *Heller 8297* (G); Lone Pine. *Jones in 1897* (Po); Deep Spring Valley, White Mts., *Purpus 5813* (UC, US). San Bernardino Co.: Cactus Flat, San Bernardino Mts., *Peirson 4605* (FP, Po); Twenty-nine Palms, *Alverson in 1898*, type of *P. rosulata* (UC); Keyes Ranch, Little San Bernardino Mts., *Munz 4531* (Po), *Munz & Johnston 5248* (G, Po); Desert Queen Mine, *Jaeger 254* (Po), *446* (US); Garden of Gods, Little San Bernardino Mts., *Jaeger 429* (US). Riverside Co.: Chino Creek, *Hall 2605*, type of *P. acuminata* (UC). San Diego Co.: Walkers Ranch, near Jacumba, *Abrams 3686* (G, St, NY). Lower California: Cantillas Mts., *Orcutt in 1883* (FM, G, UC); Sierras de Campo National, *Orcutt in 1883* (G); All Saints Bay, *Orcutt in 1882* (G).

To *P. saxosa* we refer a rather variable aggregate, differing widely as to number of leaflets, depth of division in each leaflet, texture of leaves, and shape of bracts. The plants that have been referred to the three species *saxosa*, *acuminata* and *rosulata* show such an inextricable maze of variations without geographic correlation, as to make it quite evident that we are dealing with a highly variable single species. If we follow Rydberg's key (No. Am. Fl. 22:299. 1908) we would place in *saxosa* all the Lower California specimens cited above, and the Lone Pine collection by Jones; while to *rosulata*

would go the other plants, except Hall's type of *acuminata*, which is apparently a shade plant. But in all these, the variations in the several characters are not correlated and there are no clearly defined segregates.

14. **Potentilla multijuga** Lehm., Ind. Sem. Hort. Bot. Hamb. 1849:6. 1849.

Potentilla multijuga Lehm. Rev. Pot. 29. pl., 7. 1856. Rydb. Monog., Pot., 110, pl., 48. 1898. Bull. Torrey Club 23:434. 1896. No. Am. Fl. 22: 346. 1908. Wolf, Monog. Pot., 490. 1908. Abrams, Fl. L. A., 179. 1917 and 198. 1904. Davidson & Moxley Fl. So. Calif., 177. 1923. *Potentilla plattensis* of Davidson, Cat. Pls. L. A. Co., 8, 1896.

Perennial, with a taproot and almost no caudex; stems few, erect, 3-7 dm. high, slightly silky-strigose, somewhat leafy; lower stipules 2-2.5 cm. long, glabrous, with free lance-ovate tips 5-7 mm. long; cauline stipules, ovate, entire or toothed, 5-20 mm. long; leaves pinnate; basal leaves numerous, 1-3 dm. long; petioles 6-12 cm. long, glabrate; leaflets 11-27, sparsely strigose to glabrate, 1-4 cm. long, cuneate-obovate, with few coarse teeth above the middle; cauline leaves much reduced, few foliolate to simple; flowers in loose strict cymes; pedicels ascending, 10-30 mm. long; hypanthium 4-6 mm. broad, very sparsely pubescent; sepals oblong-ovate, acute, glabrate; bractlets ovate or elliptical, spreading; petals conspicuous, yellow, broadly obcordate, ca. 7 mm. long; stamens about 20, borne on disk close to base of receptacle, pistils numerous; styles subterminal, filiform.

Definitely known from a single station in our region, in a marsh west of Los Angeles, in the Coastal Sagebrush Association. Los Angeles Co.: Flats near Ballona, *Hasse 4950*, in 1890 (D, NY, US); moist meadow near Los Angeles, *Hasse in 1893* (NY); brackish meadow, near Los Angeles, *Hasse in 1891* (G, Mo).

15. **Potentilla Anserina** L., Sp. Pl., 495. 1753.

Potentilla Anserina L. Fernald, Rhodora 11:8. 1909. *Argentina Anserina* (L). Rydb., Monog. Pot., 159. 1898. Rydb. No. Am. Fl. 22: 353. 1908. Davidson & Moxley Fl. So. Calif., 177 1923, in part. *Argentina Anserina concolor* (Ser.) Rydb. Monog., 160. 1898. *Potentilla Anserina* var. *concolor* Ser. in DC. Prodr. 2:582. 1825. Parish, Pl. World 20:218. 1917.

Low perennial with cluster of fascicled roots and a short caudex bearing rosette of leaves and one or more pubescent stolons one to several dm. long; stipules of basal leaves 1-2 cm. long, with ovate to lanceolate, free hyaline tips 4-8 mm. long; stipules on stolons silky, ovate, lacerate into few sharp teeth; leaves pinnate, silvery-silky, especially below, upper surface often much the greener and almost glabrous; basal leaves spreading, 5-20 cm. long; petioles 1-5 cm. long, spreading silky-villous; leaflets 9-31, with smaller subsidiary ones interposed, 0.5-4 cm. long, oblong to oblong-lanceolate, deeply and sharply serrate; leaves on stolons much reduced; peduncles axillary, solitary, single flowered, about equaling leaves; hypanthium saucer-shaped; sepals ovate or ovate-oblong, acute; bractlets oblong, about equaling sepals; petals very conspicuous, obcordate, 8-12 mm. long, yellow; stamens ca. 20, closely arranged about base of receptacle; filaments subulate, somewhat dilated; pistils very numerous; styles filiform, lateral; achenes very plump, corky, deeply dorsally grooved.

Known in our region only from the San Bernardino Mts., where it grows in moist alkaline soil, about Bear and Baldwin Lakes, at elevations of about 6,500 ft., in the Montane Forest Climax. San Bernardino Co.: Bear Lake, *Munz 5712* (Po); Baldwin Lake, *Johnston in 1924* (Po), *Peirson 4593* (FP); San Bernardino Mts., *Hall 1034*

(UC); Bear Valley, *Harwood 4337* (Po), *Jones in 1900* (Po), *Parish 1499* (Mo, St, US), *Parish 3154* (Mo, US). The last four collections named are silky-strigose above as well as below and belong to the variety *sericea* Hayne (Fernald, Rhodora 11:8. 1909).

16. **Potentilla pacifica** Howell. Fl. N. W. Am. 1:179. 1898.

Potentilla pacifica Howell, Fernald, Rhodora 11:8. 1909. *Argentina Anserina* of Davidson, Cat. Pls. L. A. Co., 8. 1896. Davidson & Moxley, Fl. So. Calif., 177. 1923, in part. Of Abrams, Fl. L. A., 199. 1904 and 180. 1917. Yates, 9th Rep. State Mineralogist of Calif., 15. Greene, Pittonia 1:80 & 87. 1887. Brandegee Zoe 1:136. 1890.

Similar to *Anserina*, but with stolons, petioles, rachises and peduncles glabrous or glabrate; leaves suberect, 0.3-5. dm. long, with 7-31 oblong, oblanceolate, or obovate leaflets, green above, white-tomentose to glabrate beneath, the pubescence when present being opaque and dull and not lustrous nor sericeous; achenes less plump, not corky nor grooved.

Apparently confined to coastal marshes where it may be locally frequent, but has been seldom collected. In the Coastal Sagebrush Association, San Luis Obispo Co.: San Luis Obispo, *Jones in 1883* (Po); Pismo Beach, *Peirson 1983* (FP); Arroyo Grande, *Alice King in 1895* (UC); Morro, *Barber* (UC). Ventura Co.: Oxnard, *Davy 7807* (UC). Los Angeles Co.: Near Santa Monica, *Barber 131* (UC); Los Angeles Co., *Grant 6313* (St); Los Angeles, *High School collectors in 1904* (Po); Ballona Creek, Mesmer, *Abrams 1463* (St); Ballona, *Johnston 1336* (Po, St) *Braunton 455* (St, UC, US); Playa del Rey, *Abrams 2519* (NY, Ph, St); Cienega near Los Angeles, *Blake 853* (Ph); Cienega, L. A. Co., *Braunton 110* (US).

17. **Potentilla Sibbaldi** Hall. fil. in Ser. Mus. Helv. 1:51. 1818.

Sibbaldia procumbens L., Sp. Pl., 284. 1753. Munz, Bull. So. Calif. Acad. 23:129. 1924. Not *Potentilla procumbens* Sibth. 1794.

Perennial, frequently matted, caespitose or with elongate, scaly rootstocks; flowering stems not over 1 dm. high, strigose, few leaved; lower stipules glabrate, ca. 1 cm. long, the free portion ovate, ca. 3-5 mm. long; cauline stipules 4-8 mm. long, ovate to lance-ovate, glabrate; leaves trifoliolate, appressed-pilose; lower ones 1-7 cm. long; petioles 0.5-5 cm. long, strigosely pubescent; leaflets 1-2 cm. long, cuneate, 3-5 toothed at apex; stem leaves similar but on shorter petioles; flowers borne in small congested, flat-topped cymes somewhat projected above the foliage; pedicels 1-4 mm. long, stiffish; hypanthium deeply saucer-shaped, strigose, 2-3 mm. broad; sepals erect, oblong or obovate, obtusish, becoming 3-4 mm. long; bractlets linear-oblong, ca. 3 mm. long; petals yellowish, spatulate or obovate, shorter than sepals; stamens 5, insertion on disk separated from receptacle; filaments filiform; anthers obcordate, dehiscent by well developed lateral slits; pistils 5-20; styles lateral, filiform.

Known in our range from a single collection in the Subalpine Forest Climax of the San Bernardino Mts., at 9,000 ft. alt. San Bernardino Co.: Foxesee Creek, *Peirson 3492* (FP, Po).

18. **Potentilla glandulosa** Lindl., Bot. Reg. 19: pl. 1583. 1833.

Perennial; stems one to several, suberect, fairly coarse, 2-8 dm. high, leafy, forking above, densely glandular- or viscid-villous, generally reddish; lower stipules adnate for 0.5-3 cm., free tip lanceolate 2-4 mm. long, glandular-pubescent; upper stipules free, ovate, 3-10

mm. long, often toothed; leaves pinnate, sparsely long-pubescent, glandular, strongly bi-colored, being dark green above; lower ones 5-9 foliolate, 1-3 dm. long; petioles 1-15 cm. long, viscid-villous to glandular-pubescent; leaflets 5-40 mm. long, obovate to rhombic, serrate, often doubly so, teeth mucronate; terminal leaflets larger almost orbicular; upper leaves 3-5 foliolate, somewhat reduced, short petioled or sessile; flowers in an open cyme; pedicels 2-6 mm. long; hypanthium cup or saucer-shaped, becoming 4-8 mm. broad; sepals erect or spreading, oblong-ovate to ovate, acute; bractlets oblong, obtuse, usually conspicuous; petals conspicuous, yellow or cream colored and conspicuously veined; stamens ca. 25, borne close about base of receptacle; filaments filiform; pistils numerous; style suprabasal, fusiform, verrucose.

Key to varieties of *P. glandulosa.*

Coarse, generally exceeding 3 dm. high; inflorescence conspicuously leafy; of low altitudes...........*P. glandulosa* var. *genuina.*
Slender, generally less than 3 dm. high; inflorescence frequently not leafy; of pine belt.................*P. glandulosa* var. *reflexa.*

18a. **Potentilla glandulosa var. genuina** Wolf, Monog. Pot., 136. 1908.

Potentilla glandulosa Lindl., Bot. Reg., 19: pl. 1583. 1833. Davidson, Erythea 2:30. 1894. Brewer & Wats., Bot. Calif., 1:178. 1876. Davidson, Cat. Pls. L. A. Co., 8. 1896. List Pls. L. A. Co., 5. 1892. McClatchie, Fl. Pasadena, 638. 1895. *Drymocallis glandulosa* (Lindl.) Rydb., Monog., 198. pl. 107. 1898. No. Am. Fl. 22:372. 1908. Abrams, Fl. L. A., 204. 1904 and 180. 1917. Davidson & Moxley, Fl. So. Calif., 178. 1923. Millspaugh & Nuttall, Field Mus. Pub. Bot. 5:129. 1923. *Potentilla arguta* var. *glandulosa* (Lindl.) Cockerell, W. Am. Sci. 5:11. 1888. *Potentilla Wrangelliana* Fisch. & Avé-Lall. Ind. Sem. Hort. Petrop. 7:54. 1840. *Drymocallis Wrangelliana* (Fisch. & Avé-Lall.) Rydb., Monog., 201. pl. 108. 1898. No. Am. Fl. 22:374. 1908. Parish, Pl. World 20:218. 1917. Davidson & Moxley, Fl. So. Calif., 178, 1923. *Potentilla glandulosa* var. *Wrangelliana* (Fisch. & Avé-Lall.) Wolf. Monog. Pot., 137. 1908.

A fairly coarse plant, generally over 3 dm. high, with reddish stems; inflorescence conspicuously leafy.

Frequent in cool shaded places in the Coastal Sagebrush and Chaparral Associations, on low hills and in lower canyons of the mountains. Usually associated with *Quercus agrifolia* and *Q. chrysolepis.* Confined to the coastal drainage, where it is most common and characteristic below 4,000 ft. alt. Santa Barbara Co.: Loma Alta, *Parish 11036* (St); Lompoc, *Suksdorf 177* (G); Carpenteria, *Brewer 260* (G, US); Santa Barbara, *Elmer 3921* (Mo, NY, St, US), *Grant 5481* (St). Ventura Co.: Sulphur Mt. Spring, Sulphur Mts., *Abrams & McGregor 54* (NY, St, US); Ojai, *Peckham in 1866* (UC, US), *Hubby 9* (UC). Los Angeles Co.: No locality, *Hasse 3752* (NY), *Hasse in 1892* (NY), *in 1891* (Mo), *Grant 2475* (NY); Topanga Canyon, Santa Monica Mts., *Munz & Harwood 3982* (Po); Griffith Park, Los Angeles, *Macbride & Payson 899* (G), *Braunton 543* (US); Los Angeles, *Davidson in 1891* (St); Altadena, *McClatchie in 1893* (NY); Arroyo Seco, *Greata 313* (UU); Oak Knoll, *Grant 325* (Mo, Ph), *Braunton 83* (US); Pasadena, *Grant 6179* (St); Sturtevants Camp, *Grant 4468* (St); Hennigers Flats, *Peirson 4276* (FP); Laurel Canyon, *Peirson 696* (FP); Sierra Madre, *Nevin 930* (G); Turnbull Canyon, *Johnston 1894* (NY, Po, St); Puente Hills, *Munz 2182* (Po); Live Oak Canyon, *Shaw in 1900* (Po); Lone Hill near San Dimas, *Parish 19266* (G, UC), *Munz, Street & Williams 2493* (Po); Claremont, *Crawford in 1915* (Po, US), *Robinson in 1916* (Po). Orange Co.: Laguna Beach, *Johnston 1893* (NY, Po). San Bernardino Co.: San Bernar-

dino, *Parish 4471* (G, NY, St, Mo), *Parish 4777* (NY, St, US); Canyon Diablo, *Parish in 1898* (NY), *11902* (UC), *4471* (FM, US, NY); San Bernardino Mts., at 3,000 ft., *Parish 6376* (UC); Foothills, San Bernardino Mts., *Parish 291* (St, US); Foothills San Bernardino Co., *Parish in 1888* (FM); Waterman Canyon, *Parish 11391* (Po, UC). Riverside Co.: Temecula, *S. B. & W. F. Parish 803* (G); Temecula Canyon, *Johnston 1873* (NY, Po); Hemet Valley, *Munz & Johnston 5534* (Po); San Juan Road near Elsinore, *Baer in 1921* (Po), San Diego Co.: San Luis Rey River, *Orcutt in 1882* (FM); Pala Canyon, *Parish 4517* (NY); Fallbrook, *Cleveland in 1881* (UC), *Hall 508* (UC); Descanso, *T. S. Brandegee in 1906* (UC), *Spencer 2286* (G), *Spencer 2287* (G); Mesa Grande, *Spencer 1332* (G, Po); Julian, *T. S. Brandegee in 1894* (UC), *Orcutt in 1889* (Mo);Spencer Valley, *Abrams 3793* (G, Mo, St, NY); Cuyamaca Mts., *Hall in 1899* (UC); Campbells Ranch, Laguna, *Mearns 3534* (St. US); Green Valley, near San Diego, *Collins & Kempton 142* (US); San Diego, *Spencer 128* (G, UC, US); Alpine, *Mearns 3947* (US); Canyon de los Negros, *S. B. & W. F. Parish 783* (US); San Miguel Mt., *Chandler 5216* (NY, St); Campo, *McGregor 2077* (St). Lower California: No. Low. Calif., *Orcutt in 1885* (UC); San Pedro Martir, *T. S. Brandegee in 1893* (UC).

Such plants as *Abrams 3793*, the *Hall* specimen from the Cuyamacas, the *Brandegee* collections at Julian and in the San Pedro Martir are from intermediate altitudes and are very difficult to place definitely. They are quite intermediate between var. *genuina* and var. *reflexa.*

Glandulosa and *Wrangelliana* are recognized as two distinct species by Rydberg and as a species and variety by Wolf on the basis of narrow sepals and bright yellow flowers for *glandulosa*, and broader sepals and whitish flowers for *Wrangelliana.* The former, as figured in Lindley's plate does have narrow sepals and yellow flowers and is based on material collected by Douglas in California. Material at the Gray Herbarium collected by Douglas does not sustain these distinctions.

18b. **Potentilla glandulosa** var. **reflexa** Greene, Fl. Fran., 65. 1891.

Potentilla glandulosa var. *reflexa* Greene, Wolf, Monog., 138. 1908. *Potentilla reflexa* Greene, Pittonia 3:19. 1896. *Drymocallis reflexa* (Greene) Rydb., Monog., 203, pl. 110. 1898. No. Am. Fl. 22:376. 1908. Parish, Pl. World 20:218. 1917. *Drymocallis viscida* Parish, Bot. Gaz. 38:460. 1904. Rydb. No. Am. Fl. 22:375. 1908. Davidson & Moxley, Fl. So. Calif., 178. 1923. Parish, Pl. World 20:218. 1917. Johnston, Pl. World, 22:105. 1919. *Potentilla glandulosa* var. *nevadensis* of Hall, Univ. Calif. Pub. Bot. 1:87. 1902. *Potentilla glandulosa monticola* of Abrams, Fl. L. A., 200. 1904 and 178. 1917. *Drymocallis monticola* of Davidson & Moxley, Fl. So. Calif., 178. 1923 and Parish, Pl. World 20:218. 1917.

A rather slender plant, generally not exceeding 3 dm. in height, with reddish stems, highly glandular; inflorescence scarcely leafy.

Frequent in half moist places in all our mountains from 5,000 to 8,500 ft. alt., in the Montane Forest Climax. Ventura Co.: North Creek, Mt. Pinos, *Hall 6464* (UC); Saw Mill Mt., Mt. Pinos, *Hall 6524* (UC); Trail to Zaca Peak, *Eastwood 591* (US); Side of Alamo Peak, Mt. Pinos region, *Dudley & Lamb 4650* (Po, St); Liebre Mts., *Abrams & McGregor 371* (NY, St, US); Topatopa Mts., *Abrams & McGregor 95* (NY, St, US). Los Angeles Co.: Mt. Wilson, *Abrams 2585* (Mo, Ph, NY, St); Acton, *Hasse 6046* (NY); Prairie Fork, San

Gabriel River, *Johnston 2072* (UC), *2068* (Po, St, UC); Browns Flats, San Gabriel Mts., *Johnston 1753* (NY, Po, St, UC). San Bernardino Co.: Swartout Valley, San Gabriel Mts., *Munz 4599* (NY, Po), *Peirson in 1922* (FP, Po); Icehouse Canyon, *Parish 11946* (UC), *Johnston in 1918* (Po), Coldwater Fork, Lytle Creek, *Johnston 2062* (Po, St); Head of San Antonio Canyon, *Johnston 1410* (UC). San Bernardino Mts., *Blasdale in 1891* (UC), *Parish 3163* (Mo, US); Little Green Valley, San Bernardino Mts., *G. R. Hall 7* (UC); Strawberry Peak, *Parish 2364* (NY, UC); Snow Canyon, Mill Creek, *Parish 5060* (NY, St, UC, US); Mill Creek Canyon, *Crawford, July 2* (Po); Camp Vivian, *Grant 6347* (St); Deep Creek, *Parish 5806* (NY); So. Fork, Santa Ana River, *Munz 6258* (Po), *Hall 7516* (NY, Po, UC), *J. & H. W. Grinnell 230* (US). Riverside Co.: San Jacinto Mts., *Hall 719* (US); Strawberry Valley, *Hall 2204* (Mo, NY, St, UC, US), *Hasse 5689* (NY), *Hall 2039* (UC); Idyllwild, *Spencer 2173* (Po), *2198* (Po), *1861* (Po), *1862* (Po); North side of San Jacinto Mts., *Hall 2546* (UC). San Diego Co.: Palomar Mt., *Chandler 5350* (NY), *Parish 4406* (FM, Mo, NY, St, US); Cuyamaca, *Hitchcock in 1915* (US); 3 mi. so. of Cuyamaca Lake, *McGregor in 1918* (St); Laguna Mts., *T. S. Brandegee in 1904* (UC).

19. **Potentilla Hanseni** Greene, Pittonia 3:20. 1896.

Drymocallis Hanseni (Greene) Rydb., Monog., 200. 1898. No. Am. Fl. 22:373. 1908. Parish, Pl. World 20:218. 1917. Davidson & Moxley, Fl. So. Calif., 178. 1923. *Potentilla lactea* Greene, Pittonia 3:20. 1896. Hall, Univ. Calif. Pub. Bot. 1:88. 1902. *Potentilla glandulosa lactea* Greene, Fl. Fran., 65. 1891. *Potentilla glandulosa nevadensis* Wats., Bot. Calif. 1:178. 1876. *Drymocallis lactea* (Greene) Rydb., No. Am. Fl. 22:369. 1908. Johnston, Pl. World 22:105. 1919. Davidson & Moxley, Fl. So. Calif., 178. 1923. *Potentilla rupestris* var. *americana* Wolf, Monog., 129. 1908.

Perennial; stems suberect, one to several, slender, light green, glabrate or finely pubescent, inconspicuously if at all glandular, branching above; stipules of lower leaves not generally exceeding 1 cm., pilose-pubescent, free tips ca. 3 mm. long, ovate to ovate-acuminate; upper stipules reduced, ovate to lanceolate, frequently toothed; leaves pinnate, sparsely pubescent and little glandular, light green, not strongly bicolored; lower leaves 5-9 foliolate, 4-15 cm. long; petioles 1-7 cm. long, glabrate or puberulent; leaflets obovate to almost orbicular, 5-15 mm. long, often deeply and sharply serrate, terminal frequently larger, obovate to suborbicular; upper leaves reduced, uppermost trifoliolate; leaflets narrower and acuminate, almost lacking in the loose cymose inflorescence; hypanthium saucer-shaped, silky, strigose, becoming 6 mm. broad; sepals erect, lanceolate or oblong-lanceolate; bractlets small, lanceolate or linear; petals white, ochroleucous, or cream-colored, obovate, about equaling sepals; stamens ca. 25, borne near base of receptacle; filaments filiform; pistils numerous; styles suprabasal, fusiform, verrucose.

Frequent in So. Calif. from Mt. Piños to San Jacinto Mts.; growing about meadows and in fairly moist spots at from 5,000 to 9,000 ft. alt. in the Montane Forest Climax. Ventura Co.: Near Cuddys, Mt. Pinos, *Dudley & Lamb 4484* (Po. St); Griffins, *Elmer 3978* (Mo. NY, St, UC, US). Los Angeles Co.: Prairie Fork, San Gabriel River, *Johnston 2066* (Po, St, UC), *Peirson 2678* (FP); Big Pines, Swartout Valley, *Hall 1572* (St), *Peirson 5249* (FP, Po). San Bernardino Co.: Meadows above Bear Valley, *Hall 7562* (NY, UC); Green Valley, *Shaw & Illingsworth 206* (NY); Dry Lake, *Hall 7613* (NY, UC); Little Bear Valley, *Parish 10946* (St); Hunsaker Flats *Munz & Johnston 2859* (Po, St); Bluff Lake, *Peirson 5250* (FP), Riverside Co.: Tahquitz Meadow, *Spencer 1372* (NY), *Hall 2355* (Mo,

NY, St, UC, US), *Munz 5987* (Po), *Jaeger in 1921* (Po); Long Valley, *Jaeger in 1921* (Po); San Jacinto Mts., *A. W. Anthony in 1895* (UC); Tamarack Valley, *Hall 2400* (UC).

20. **Potentilla cuneifolia** (Rydb.) Wolf. Monog., 139. 1908.

Drymocallis cuneifolia Rydb., Monog., 204. pl. 111. 1898. No. Am. Fl. 22:376. 1908. Parish, Pl. World 20:218. 1917. Davidson & Moxley, Fl. So. Calif., 178. 1923.

Perennial; stems one to few, erect, slender, branching above, 1-4 dm. high, glabrate to sparsely glandular-villous, especially below; lower stipules 0.5-1.5 cm. long, free tips 3-5 mm. long, ovate; upper stipules smaller, ovate, mostly toothed; leaves pinnate, not bicolored, glabrate to almost silky and glandular; lower leaves 5- to 11-foliolate, 3-20 cm. long; petioles 1-10 cm. glabrate to villous glandular; leaflets 5-20 mm. long, cuneate-flabelliform, with coarse teeth mostly at the apex; upper leaves 3-foliolate, reduced, sessile, almost lacking in the loose corymbose cyme; hypanthium cupulate, becoming 4-5 mm. broad; sepals ovate or deltoid ovate, erect; bractlets minute, oblong, erect; petals yellow, erect, obovate, only a little exceeding sepals, 4-5 mm. long; stamens ca. 20, borne close about base of receptacle; filaments filiform; pistils numerous; styles filiform, several times length of achene.

A little known species, apparently confined to the desert slopes of the mountains south of the Mohave Desert and known from the very lower part of the Montane Forest Climax. Los Angeles Co.: Mt. Islip, *Peirson 2801* or *493a* (Po, FP); South Fork, Rock Creek, *Peirson 493* (FP, Po). San Bernardino Co.: Green Lead Mine, San Bernardino Mts., *Parish 1818*, type collection (FM, G, NY).

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LOS ANGELES, CALIFORNIA

Nostra tuebimur ipsi.

Vol. XXIV May-August, 1925 Part 2

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All figures slightly reduced.

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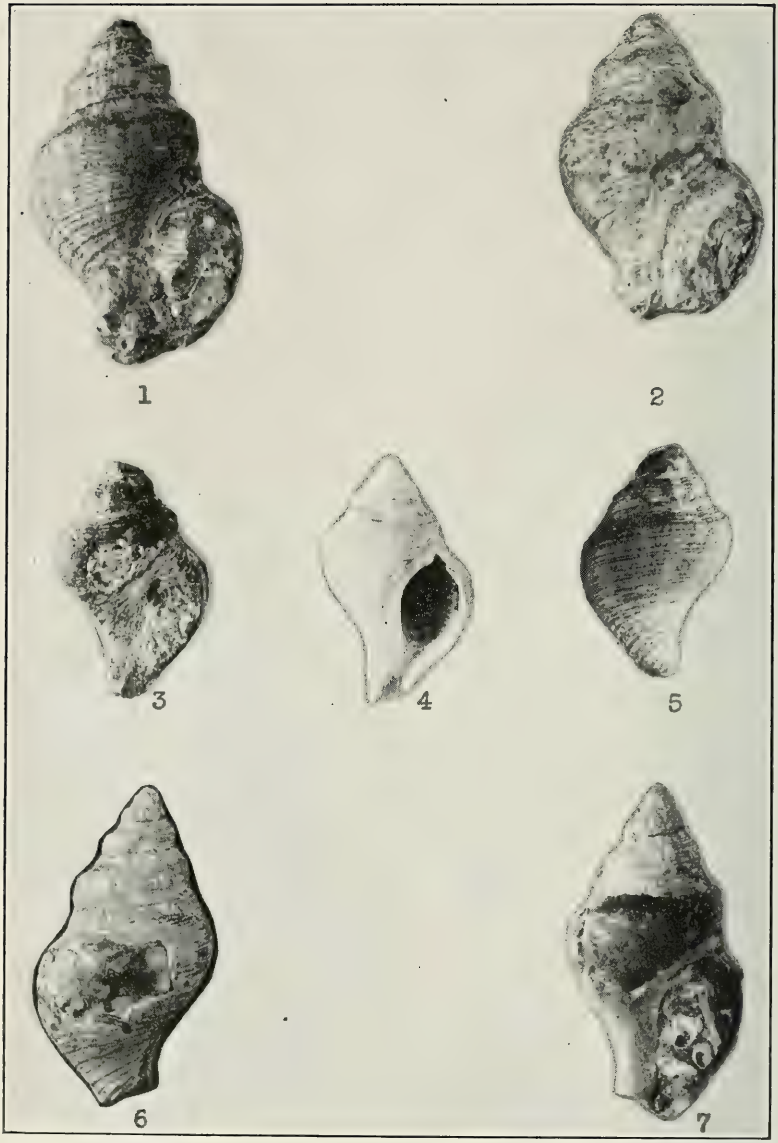
Plate 1.



SOME NEW SPECIES FROM THE PLIOCENE
OF
SOUTHERN CALIFORNIA
WITH A FEW CHANGES IN NOMENCLATURE

By
CARLTON M. CARSON
Stanford University

Cantharus breaensis n. sp.

Plate I. Fig. 2

Shell thick, ventricose; spire moderately high with five rapidly enlarging whorls; whorls rounded and shouldered above; suture distinct, forming a wavy collar on the whorl above; sculptured with numerous fine, square-topped, spiral, ribs; interspaces wide, carrying intercalaries, few above the shoulder but many below; axial sculpture consists only of numerous fine incremental lines; aperture ovate; pillar straight, carrying a single low, rounded, fold near the juncture of the outer lip and columella; outer lip rather thin, inside concealed, but another specimen shows it to be crenated within; canal open, recurved; external siphonal fasciole partially broken, but was apparently heavy. Height of type 47 mm., diameter of type 31 mm., apical angle about 67°.

Localities:—Mouth of Brea Canyon, Puente Hills, Los Angeles Co., Calif. Fernando Formation, lower Pliocene. Collected by C. M. Carson. Also from the Fernando Formation of the Camulos Sheet, Los Angeles Co., Calif. Collected by L. C. Decius.

Common associates of this form at Brea Canyon are: *Alectrion fossatus* Gould, *Alectrion moranianus*, Martin, *Arca trilineata* Conrad, *Cardium quadri genarium* Conrad, *Fusinus barbarensis* Trask, *Ostrea veatchii* Gabb, *Pecten ashleyi* Arnold, *Pecten oweni* Arnold, *Pecten etchegoini* Anderson, and *Turritella cooperi* Carpenter.

Cantharus ashleyi n. sp.

Plate I Figs. 6 and 7

Shell slender; spire high, with six rapidly enlarging whorls, body whorl rounded but not shouldered, earlier whorls vertical and distinctly shouldered; suture distinct forming a wavy collar on the earlier whorl; sculpture consisting of numerous fine, rounded, spiral, ribs and narrow interspaces carrying, in some cases, fine intercalaries; axial sculpture consists of small nodes on the earliest three whorls, 10 nodes to a whorl and a few incremental lines; aperture pyriform; pillar slightly curved and smooth carrying a single high rounded plait near junction of outer lip and columella; canal partly broken off, outer lip rather thin, inside crenated. Height of type 51 mm., diameter of type 28 mm., apical angle 60°.

Localities:—Near the San Fernando Tunnel, Los Angeles Co., Calif., Fernando Formation, lower Pliocene. Collected by G. H. Ashley. Another specimen from Gavin Canyon, Camulos Sheet, Los Angeles Co., Calif., collected by C. M. Carson, shows the canal to be open, slightly recurved and the external siphonal fasciole to be quite heavy. Height of paratype 54 mm., diameter of paratype about 31 mm., apical angle 61°.

This species is named for G. H. Ashley, who collected the type specimen.

Associates:—At the Gavin Canyon locality *Alectrion moranianus* Martin, *Dosinia ponderosa* Gray, *Macoma nasuta* Conrad, *Ostrea veatchii* Gabb, *Turritella cooperi* Carpenter and *Pecten cerrosensis?* Gabb are commonly found.

Cantharus elsmerensis n. sp.

Plate I Fig. 4

Shell thin, spire rather low with five or six rapidly enlarging whorls, whorl rounded and angulate above; suture distinct, forming a wavy collar on the whorl above; sculptured with about thirty-six narrow, square-topped, spiral, riblets of which eleven are above the angle of the whorl; interspaces narrower than the riblets; toward the base of the body whorl a few intercalaries appear; axial sculpture consists of about ten small nodes on the upper two or three whorls, becoming obsolete on the later whorls; a few fine incremental lines are present; aperture pyriform; pillar somewhat curved carrying one narrow horizontal fold near the junction of the outer lip and pillar; outer lip internally crenated, canal short, open, slightly curved; external siphonal fasciole almost lacking. Height of type 37 mm., diameter of type 23 mm., apical angle 72°.

Localities:—Holser Canyon, branch of Piru Valley, Ventura Co., Calif. Fernando Formation, lower Pliocene. Collected by C. M. Carson. Also from Elsmere Canyon near the forks, Ventura Co., Calif. Collected by R. B. Moran. This specimen minus the apex and part of the canal measures 46 mm. in length, and 33 mm. in diameter.

Associated with this species at the Holser Canyon locality are *Amiantis callosa* Carpenter; *Arca camuloensis* Osmont, *Chione fernandoensis* English, *Ostrea veatchii* Gabb, *Pecten healeyi* Arnold, *Pecten oweni* Arnold, *Turritella cooperi* Carpenter and *Fusinus barbarensis* Trask.

Solenosteira angelensis n. sp.

Plate I Figs. 3 and 5

Shell thick, ventricose, spire low with three rapidly enlarging whorls and part of a fourth, apex broken; body whorl rounded and angulate above; suture distinct; sculpture consisting of 22 rounded, major, spiral, ribs with narrow interspaces usually carrying a thread-like intercalary; axial sculpture consists of nodes on the angle of the upper whorls, there being thirteen on the penultimate whorl, and none on the last whorl where they are obsolete; incremental lines are visible on the last whorl; aperture narrow and elongate; outer lip thin, inside concealed, columella straight, smooth, callus thin, canal open, rather wide and slightly curved, external siphonal fasciole very feeble, umbilical pit very shallow or almost lacking. Height of type 36 mm., diameter of type 23 mm., apical angle 72°.

Locality:—Mouth of Brea Canyon, Puente Hills, Los Angeles Co., Calif. Fernando Formation, lower Pliocene. Collected by C. M. Carson. One specimen.

Associates:—*Alectrion perpinguis* Hinds, *Arca multicostata* Sowerby, *Argobuccinum pacificum* Dall, *Bursa californica* Hinds, giant *Conus*, *Pecten ashleyi* Arnold, *Pecten oweni* Arnold, *Pecten hastatus* Sowerby, and *Thracia trapezoides* Conrad are commonly found in the Fernando Formation of the Puente Hills.

Cantharus fortis, Carpenter

Pisania fortis Carpenter., Ann. and Mag. Nat. Hist., 3rd Ser. Vol. 17, April 1866. pp. 277, Cooper, 7th Ann. Rept. Cal. St. Min. 1888, p. 260. Arnold Mem. Cal. Acad. Sci. Vol. 3, pp. 227.

"P. testa P. insigni simili, sed solidiore; crassissima, sculptura valde impressa; anfr. norm. v., parum rotundatis, suturis distinctis, costis radiantibus t. juniore circ. XII., obtusis, parum expressis, postea obsoletis; liris spiralibus validis, cebris (quarum t. juniore V., postea X., in spira monstrantur), subaequalibus, anticis majoribus; canali recurvata; lacuna unbilicali magna; labro intus crebrilirata; labio conspicuo, spiraliter rugose lirato.

Hab.—Santa Barbara, Pleistocene Formation. (Jewett.)"

Cantharus fortis closely resembles the living *C. elegans Gray*, but differs from it in having finer and closer internal ribbing on the outer lip, in having a greater tendency to develop intercalaries on the surface, in being less nodose on the body whorl, and in having more, and more prominent plaits on the columella.

Localities:—Santa Monica Canyon, Los Angeles Co., Calif., San Diego Formation, lower upper Pliocene. Collected by D. Arnold. Four miles west of Santa Barbara, Santa Barbara Co., Calif., Santa Barbara Formation, upper Pliocene; Timber Canyon, Santa Paula, Ventura Co., Calif., Ventura Formation, upper Pliocene, collected by C. A. Waring. San Pedro, Los Angeles Co., Calif., upper San Pedro Formation, upper Pleistocene.

Close study of this species and of the genera *Pisania* and *Cantharus* has convinced the writer that *Pisania fortis* should be assigned to the genus *Cantharus.*

Searlesia portolaensis Arnold.

Fusus portolaensis Arnold.

Proc. U. S. Nat. Mus. Vol. 34, pp. 345-390. Pl. 37, Fig. 8.

"Description—Shell attaining a length of at least 60 mm., fusiform, moderately slender; apex acute, whorls 7 or more, very convex, slightly compressed above near suture; nuclear whorls unknown; the next four crossed by nine very broad, prominent, rounded varices extending from lower suture to upper revolving sutural ridges; interspace between varices deep and V-shaped; about 8 sharply defined, rounded, revolving ribs (between each pair of which on the lower whorls is often a small intercalary) occur on each whorl in addition to the sutural rib which is more prominent than in the others; whole surface crossed by numerous small incremental lines; body whorl quite regularly convex, projected into a long, slightly outward-curving pillar, varices obsolete, or nearly so, on the body whorl, and also on the penultimate whorl on the larger specimens, as in F. barbarensis Trask; suture distinct, wavy. Aperture elongate-elliptical; outer lip internally striate, inner lip smooth, gently concave; canal rather long, narrow, curved outward toward anterior extremity.

Dimensions—Length, 62 mm., latitude, 31 mm., longitude of body whorl, 44 mm., longitude aperture and canal, 34 mm., apical angle about 49°."

Horizon—Purisima formation and Fernando formation, lower Pliocene.

"Localities—Santa Cruz quadrangle, San Mateo County, locality No. 6, on Sausal Creek, one-half mile southwest of Portola, also occurs at about the same horizon at several localities in eastern Monterey County and western Fresno County, type locality, U. S. G. S. No. 4665, Etchegoin (upper Miocene or lower Pliocene) formation, White Creek, 19 miles northwest of Coalinga, Fresno County."

Also from Fugler's Point, Asphalt Mine, Santa Maria, Santa Barbara Co., Calif. Fernando Formation, lower Pliocene. Collected by J. O. Lewis.

Careful comparison with the living *Searlesia dira* Reeve shows this species to be of the same genus but different specifically. *S. portolaensis* differs from *S. dira* in attaining somewhat greater size, in being more nodose, in being slightly more ventricose, and in having a much larger apical angle (47° as against 38°). *S. portolaensis* resembles *Kellettia kelletii* Forbes, but is more slender, has a shorter canal, is smaller, and is much less nodose on the last whorl. Specimens of *S. portolaensis* Arnold from the Fugler's Point locality differ from those from the Purisima Formation in being somewhat nodose on the penultimate and body whorls, but the difference was not considered specific.

Cantharus arnoldi Rivers.

Plate I Fig. 1

Chrysodomus arnoldi Rivers.
Bull. So. Calif. Acad. Sci. Vol. 3, No. 5. 1904. Pg. 70.
Chrysodomus arnoldi Rivers, Arnold.
Proc. U. S. Nat. Mus. Vol. 32, Pl. 50, Fig. 10.
Chrysodomus arnoldi Rivers, Arnold. U. S.
G. S. Bull. 309, Pl. 40, Fig. 10.

"Shell thick, robust, chalk white; elegantly fusiform; spire about one-fifth of the whole; spire compressed; whorls about five; nucleus and following whorl missing; the third and fourth whorls are sculptured with rather wide transverse ridges; but on the fifth whorl the ridges are nearly obsolete; sutures roughly encrusted; body whorl strongly shouldered, but not tabled; the sculpture consists of fine revolving flattened striae or ridges crossed at intervals by strong incremental lines which perhaps in an unworn example might show varices; in the fossil there appears faintly a cancellate pattern; all the whorls bear an alternate series of fine revolving ridges which on the body whorl gages two to a mm.; columella medium, twisted; channel open but shallow; incrusted thickly interiorly; aperture pyriform; unbilicus subperforate as in Pisania fortis Carp.

Dimensions: Long. 40 mm., Lat. 29 mm.
Geological formation, Pliocene. One specimen.
Locality: Crawfish George's; San Pedro, Calif."

This species was described but not figured by Prof. J. J. Rivers. it was recognized and figured unaccompanied by the original description by R. Arnold and is now being refigured with the original description. Comparison of this species with the genus *Cantharus* shows it to be a *Cantharus*. It has the fold on the columella usually found in *Cantharus*.

Localities:—Elsmere Canyon, Los Angeles Co., Calif. Fernando Formation, lower Pliocene. Holser Canyon near Piru Valley, Ventura Co., Calif., Fernando Formation, lower Pliocene. Collected by C. M. Carson.

Cantharus angulatus Arnold.

Pisania fortis var. angulata Arnold. Proc. U. S. Nat. Mus. Vol. 32, 1907. pp. 536. Pl. L. figs. 6 and 7.

"Description—Shell fusiform, short; spire elevated; apex subacute to subangular, whorls angular, about three-fourths of the whorl being below the angle; body whorl below the angle quite uniformly convex. The surface sculpture varies considerably in individual specimens; in the type the sculpture of the body whorl consists of ten equal subequidistant rounded subrugose spiral ridges, each interspace being

ornamented by one less prominent but slightly more rugose revolving line on each side of which still finer lines may often be distinguished; above the angle are five revolving lines, less prominent than those on the lower part of the whorl, but alternating in relative size in the same manner as the latter. The penultimate and earlier whorls have about eleven longitudinal waves or low ribs which become most prominent on the angle of the whorls, forming more or less prominent nodes. A prominent sutural riblet is developed on the posterior portion of the whorl. Suture wavy, appressed, distinct. Aperture pyriform; outer lip unknown but probably denticulate. Unbilicus subperforate.

Dimensions:—Longitude (restored), about 55 mm., latitude, 29 mm., body whorl, 43 mm., aperture, 30 mm., deflection, about 62°.

Notes:—This variety differs from the typical **Pisania fortis** Carpenter, in being broader and in having prominently angulated whorls. The revolving lines in the former are also usually weaker than in the typical form."

"Locality—Elsmere Canyon near Union Oil Company's wells, 2½ miles southeast of Newhall, Los Angeles County, Calif." Collected by Ralph Arnold.

"Horizon—Middle Fernando Formation (lower Pliocene). Known only from the type locality where several specimens were found."

Examination of specimens of this form shows the inside of the outer lip to be crenated as Arnold suggested, and also revealed several low folds on the anterior portion of the columella and also a stronger fold on the columella near its junction with the outer lip, as in *Cantharus*. This form differs from *Cantharus fortis* Carpenter, in being more ventricose, less nodose, in having the major spiral ribs closer together, and in having the intercalaries much finer. For these reasons it has been raised to specific rank and assigned to the genus *Cantharus*, Arnold's varietal name being retained.

Locality—Calabasas Region, Los Angeles Co., Calif., Fernando Formation, lower Pliocene.

EXPLANATION OF PLATE

(All figures approximately natural size).

		Pg.
Fig. 1.	Cantharus arnoldi Rivers	34
Fig. 2.	Cantharus breaensis n. sp.	31
Fig. 3.	Solenosteira angelensis n. sp.	32
Fig. 4.	Cantharus elsmerensis n. sp.	32
Fig. 5.	Solenosteira angelensis n. sp.	32
Fig. 6.	Cantharus ashleyi n. sp.	31
Fig. 7.	Cantharus ashleyi n. sp.	31

Photographs by Crandall of Palo Alto

Plate 2.

The Southwest Museum has recently come into possession of a remarkable library of Californiana through a bequest of the late Judge Grant Jackson. This includes a set of the Bulletin, Southern California Academy of Sciences, which is complete except for the single issue of Volume 3, No. 8. It is earnestly hoped that some reader of the Bulletin may be able to supply this number.

STUDIES IN PACIFIC COAST LEPIDOPTERA

DR. JOHN A. COMSTOCK

A New Race of Mitoura siva Edw. in California

A number of years ago I took a small series of greenish *Mitoura* in the juniper belt on the north-eastern slope of the Sierra Madre Mountains, in Mint Canyon, which I thought at the time were *M. loki* Skinner. A few of these were sent to Dr. Skinner who wrote me tnat they were not his species, but were probably close to *siva.* I have recently received, through the kindness of Dr. Barnes and Benjamin, a series of *M. siva* from Arizona. An examination of these convinces me that the Mint Canyon form is a connecting link between *siva* and *loki.* My opinion is further borne out by Dr. Benjamin to whom I have submitted specimens. I therefore propose for this form the name.

Mitoura siva Edw. form *juniperaria* form nov.

Expanse: ♂ 15/16 inches; ♀ 1 inch.

♂ *Superior surface*, primaries: ground color wood-brown, flushed in the center of the wing with a lighter, more lustrous shade of brown very much as in siva.

Secondaries similarly colored, and practically the same as siva except that both of the tails average only 2/3 the length of the last named species.

Inferior Surface, primaries: ground color light brown powdered with green in basal area and at apex. An extra-median interrupted white band crosses the wing but is obsolescent in the posterior one-third. This is shaded internally with a darker brown line. In all of these particulars it does not differ from *siva.*

The characteristic markings are confined to the *secondaries*, which are predominantly of a green color. A fine black marginal line occurs as in *siva.* Internal to this is a bluish field (actually composed of a mixture of black and white scales) which is widest near anal angle, and tapers out as it approaches the costal angle. This blue field is much more pronounced than in *siva.* A minute black ocellus occurs in this field at a point where it would form a right angle triangle with lines extended to the base of the tails. This point is about one-fourth the area of the equivalent ocellus in *siva.* Internal thereto are a few orange scales, but not an orange lunule as in the species with which we are comparing it.

Internal to the blue field is an area of green which is widest at the costal angle and tapers toward anal angle. This field is restricted in *siva* and does not extend posterior to the aforementioned ocellus, whereas in our species it extends nearly to the anal angle. Between the blue and green fields are a series of black ovate spots, the largest of which is anterior to the submedian vein. These are typically four in number. A prominent recurved white band crosses the median area. This begins, in our species, at a point about half way between the costal angle and base, whereas in *siva* it originates about 1/3 internal to the costal angle: also it curves sharply inward toward the disc in our species, whereas in *siva* it follows a fairly straight course posteriorly. One fairly constant feature of siva is the W mark in this line lateral to the disc. This is not prominent in juniperaria, and ceases altogether in *loki*, as a reference to our plate will show. The basal area in our species is usually a clear field of green, but about one out of every four show a slight suggestion of the extra-basal line which is so prominent a feature of loki. In all other respects our species resembles *siva.*

♀ much like ♂ except for the greater amount of the light lustrous brown on superior surface of wings.

Types: Described from 37 males, 25 females, all taken at Mint Canyon, Sierra Madre Mts., Cal. Fifty-three spec. April 14th to 30th, 1923. Nine spec. May 5 to 8, 1925.

This is the species that Mr. Karl Coolidge dealt with in his description of the early stages of Thecla loki in Entomol. News, Vol. 35, No. 6, 1924. Undoubtedly the preliminary stages of all members of the group including *castalis* and *loki* are very similar.

BUTTERFLIES OF CALIFORNIA—Continued

DR. JOHN A. COMSTOCK

GENUS ANTHOCHARIS Hubner.

The Marbles.

The Pima Orange-Tip (Anthocharis pima Edw.) is the handsomest member of the genus occuring in our territory. It is a rare capture in this state, being reported only from the territory adjacent to the Colorado River. It is the characteristic orange-tip of our neighboring state of Arizona, where the Indian tribe for which it was named is resident. Like all the Anthocharids it is an early spring form, with February and March as the favored months. Nothing is known of the early stages. The insect is pictured on plate XI, figures 4, 5, and 6, shown in this issue of the Bulletin.

The Sara Orange-Tip (Anthocharis sara Bdv.) is a somewhat variable member of the genus, in consequence of which several forms have been named. The early spring brood is charactrized by a heavier green mottling of the underside, with an intensification of all black markings. This was named *reakirti* by Edwards. (Plate XI, figures 10, 11, and 12.) A dimorphic female is not uncommonly taken, in which a suffusion of deep yellow covers the upper surfaces of both wings. This is known as *stella*. (Plate XI, figures 13 and 15.) Intergrades occur between this and the typical insect. In the higher mountains a form, which has been designated *julia*, (Plate XI, figure 14), is occasionally encounterd in which a light lemon yellow suffuses the upper surfaces of the wings in the male, and the black markings are much reduced, and tend toward a disappearance of the band which separates the orange tip from the white field of the forewing. The female of this form is practically indistinguishable from *stella*. The author has distinguished an aberrant form which he has named for Mr. W. S. Wright of San Diego, in which the black markings are extremely heavy, practically obscuring the orange spot and causing a striated appearance of the upper side of secondaries. (Plate XI, figure 16.) Mr. Jean Gunder has described a form in which the usual orange tip is replaced by yellow. This was named *sternitzki* after Mr. R. F. Sternitzky of San Francisco.

The Sara Orange-Tip never fails to bring a thrill of delight to the heart of the lepidopterist as it pursues its impetuous course through our wooded canyons, or sports over the mustard-spangled foothills in search of succulent *Arabis* or *Raphanus* on which to oviposit. The warm days of early spring are certain to bring it forth in abundance, but never to wander far from its chosen verdant haunts. It is found throughout the entire state.

The colored plate in our last issue of the "Bulletin" was overprinted Plate XI in error. It should have been designated Plate X.

NEW SPECIES OF MARINE FOSSIL MOLLUSCA FROM WESTERN NORTH AMERICA

—— By ——

LEO G. HERTLEIN

New species of fossil mollusca in the Paleontological collections of the Leland Stanford Junior University, from the Jurassic and Tertiary of western North America, are described in this paper. The writer wishes to acknowledge the kind help received from Dr. J. P. Smith in the preparation of this paper; he also wishes to thank Mr. E. K. Jordan and Mr. C. H. Crickmay for help in the preparation of the manuscript. Acknowledgement is also due Mr. B. L. Cunningham, H. Hannibal, H. J. Hawley and A. W. Ambrose, for the collection of the material described in this paper. The types and paratypes are in the type Paleontological collection of the Leland Stanford Junior University.

The new species described are:

Jurassic

Uptonia silviesi Hertlein, new species. Charmouthian, Middle Lower Jurassic.

Miocene

Pecten (*Pecten*) *hawleyi* Hertlein, new species. Vaqueros, Lower Miocene.

Pecten (*Amusium*) *condoni* Hertlein, new species. Montesano, Miocene.

Buccinum jordani Hertlein, new species. Montesano, Miocene.

Chrysodomus hannibali Hertlein, new species. Montesano, Miocene.

Pecten (*Chalamys*) *hodgei* Hertlein, new species. Santa Margarita, Upper Miocene.

Pliocene

Pecten (*Pseudamusium*) *vancouverensis fernandoensis* Hertlein, new subspecies. Fernando, Lower Pliocene.

Uptonia silviesi Hertlein, new species

Plate 3, figures 1, 2, 5.

Shell of medium size, laterally compressed; whorls 5, slightly convex on the ventral side and widely umbilicate; whorls higher than wide; sides of whorl form a squarish shoulder at the ventral edge, a slight groove present in the dorsal part of the whorl due to the impression from the earlier whorl. Whorls ornamented by numerous, closely spaced ribs which slope from the dorsal edge toward the ventral edge and at the ventral margin of the whorl each rib surmounted by a sharp node; venter almost smooth, though showing very slight ribs. Septation unknown. Diameter of largest whorl approximately 150 mm.; height of largest whorl approximately 35 mm.; thickness of largest whorl approximately 26 mm.

Type: No. 99 (L. S. J. U. Type collection), from Loc. 27 (L. S. J. U.), in dark red sandstone, section 7, T. 20 S, R. 30 E., Tim Donovan's ranch near Silvies River, 18 miles north of Burns in Harney County, Oregon; B. L. Cunningham collector. Age, Charmouthian. Middle Lower Jurassic.

Associated fauna occurring with *Uptonia silviesi* Hertlein is: *Anatina* sp., *Gervillia* sp., *Pecten acutiplicatus* Meek, *Pleuromya concentrica* Meek, *Pleuromya depressa* Meek, *Pholadomya multilineata* Gabb, *Pholadomya* cf. *nevadana* Gabb, *Pholadomya* sp.

This is apparently the same fauna as found in the Hardgrave sandstone of northern California. The presence of the genus *Uptonia* in eastern Oregon appears to place the stratigraphic position of the Hardgrave sandstone as middle Lias: In England the Genus *Uptonia* is restricted to the Charmouthian Series by Buckman.

Pecten (Pecten) hawleyi Hertlein, new species

Plate 4, figures 4, 5.

Shell small, moderately thick, inequivalve. Right valve moderately convex, the point of greatest convexity being about one-third the distance from the apex to the ventral margin of the disk, the umbos gently rounded to the plane of the ears; surface ornamented by 17 to 18 prominent, sharply rounded ribs with nearly flat interspaces, toward the posterior extremity the ribs become flattened, and broader, and the interspaces broader proportionately; toward the periphery of the disk the ribs become somewhat less elevated and the sides of the ribs are more sloping to the flattened interspaces, in addition the surface of the right valve is ornamented by closely spaced, very fine, concentric lines, which are most prominent near the periphery of the disk; ears ornamented by concentric lines of growth, the anterior with a small byssal notch. Left valve slightly convex, slightly depressed near the anterior and posterior dorsal margins, ornamented by 16 to 17 very narrow, round ribs which expand but slightly towards the periphery of the disk, and are separated by interspaces wider than the ribs, the surface also sculptured by numerous fine, concentric growth lines which are more prominent than those on the right valve; ears crossed by very fine lines of growth. Height 32 mm.; length 34 mm.; apical angle of left valve approximately 125°.

Type: Left valve No. 19 (L. S. J. U. Type collection) from L. S. J. U. Geol. Surv. Loc. 860, upper beds of the Vaqueros sandstones, Santa Inez Mountains, Santa Barbara County, California; H. J. Hawley collector, Vaqueros Miocene; *Paratype*: right valve No. 22 (L. S. J. U. Type collection), same locality.

Pecten hawleyi Hertlein resembles *P. sanctaecruzensis* Arnold, but the present species is smaller, has a greater number of ribs, and has more prominent concentric sculpture on both valves than *P. sanctaecruzensis*.

At the type locality *P. hawleyi* Hertlein is associated with: *Pecten vanvlecki* Arnold, *Rapana vaquerosensis* Arnold, *Turritella inezana* Conrad.

This species is named in honor of Mr. H. J. Hawley who collected the type specimen.

Pecten (Patinopecten) kernensis Hertlein, new species

Plate 4, figure 3.

Shell large, slightly arched, moderately thick. Right valve ornamented by about 22 to 24 fairly high, flattish topped, round edged, radiating ribs of unequal size, separated by slightly rounded interspaces which are narrower than the ribs, many of the interspaces sculptured by a tiny midrib, whole surface ornamented by fine concentric lines of growth; anterior ear large, bearing a large byssal notch, ear ornamented by about 4 or 5 radiating riblets crossed by concentric lines of growth; posterior ear ornamented by about 6 radiating riblets crossed by concentric lines of growth. Height approximately 93 mm.; length approximatley 93 mm.; length of hinge line 57 mm.; apical angle approximately 100°.

Type: Right valve, No. 128 (L. S. J. U. Type collection), from Loc. 150 (L. S. J. U.) Pyramid Hill, 3 miles northwest of mouth of Kern River Canyon, Kern County, California; W. D. Kleinpell collector. Monterey, Miocene.

Pecten kernensis differs from *P. propatulus* Conrad, and *P. oregonensis* Howe, in the more numerous, unequal ribs, and less numerous, coarser ribs on the posterior ear of the present species. From *P. caurinus* Gould, *P. kernensis* is distinguished by the narrower ribs and strongly sculptured ears.

A species very similar to or identical with *P. kernensis* has been reported from the Miocene of Lincoln County, Oregon, by H. V. Howe.

Pecten (Amusium) condoni Hertlein, new species

Plate 4, figures 8, 9.

Shell of medium size, subcircular, equivalve, equilateral, somewhat compressed, of moderate thickness. Right valve ornamented by about 16 smooth, faint, radiating ribs which broaden rapidly as the shell becomes larger, at the ventral margin being about two or three times as wide as the very slight interspaces; whole surface of shell ornamented by concentric lines of growth, these in some specimens quite pronounced and in others almost wholly lacking; ears small, obliquely truncated, a very slight byssal notch present on the anterior ear, ears sculptured by numerous fine concentric lines of growth. Left valve slightly more globose at the umbo, sculptured much as right. Interior of valves ribbed. Height 73 mm.; length 73 mm.; hinge line approximately 25 mm. in length; apical angle approximately 105°.

This species is known to attain a size of 85 mm. in height and 90 mm. in length.

Type: No. 15 (L. S. J. U. Type collection); *Paratype*: No. 18 (L. S. J. U. Type collection), from Loc. 148 (L. S. J. U.=N. P. 44), at dam No. 35, West Wishkah River, Washington; H. Hannibal collector, Montesano, Miocene.

Pecten condoni is different in appearance from any other *Amusium* described from the West Coast Tertiary. The Amusiums are probably of Oriental derivation and living species of *Amusium* are now found in Oriental waters.

Pecten condoni Hertlein is associated with; *Venerella oregonensis* Conrad.

This species is named in memory of Dr. Condon, professor of Geology at the University of Oregon. The writer has adopted the manuscript name of Arnold and Hannibal.

Buccinum jordani Hertlein, new species

Plate 3, figure 3.

Shell large, robust, rather heavy, spire moderately elevated, apical angle approximately 65°; whorls about 6, flattish, in nowise angulate, separated by appressed sutures, sculptured by about 25 narrow, slightly wavy, incised grooves; axial sculpture consisting of lines of growth only; base evenly convex with sculpture similar to that of whorls; a pronounced siphonal fasciole present; canal apparently rather short; inner lip within bearing a thin callous. Height approximately 75 mm.; width of body whorl 44 mm.

Type: No. 130 (L. S. J. U. Type collection), from Loc. 152 (L. S. J. U.) 8 miles up Sylvia Creek, Montesano, Washington; H. Hannibal collector. Montesano, Miocene.

The broadly rounded whorls distinguish this from any other species of Buccinum on the west coast.

Buccinum jordani occurs at the type locality associated with *Chrysodomus hannibali* Hertlein.

This species is named in honor of Mr. E. K. Jordan.

Chrysodomus hannibali Hertlein, new species

Plate 3, figure 4.

Shell moderately large, with about 5 or 6 whorls, separated by slightly channeled sutures; semitabulate spire, apical angle approximately 65°; body whorl with 4 angles each marked by a heavy encircling cord, on the whorls of the spire but two angles and two cords are visible, in addition to the major cords the whorls are also sculptured by numerous, low, flat-topped, spiral ridges, separated by sharply incised lines, columella calloused and smooth. Height approximately 65 mm.; width of body whorl approximately 43 mm.

Type: No. 129 (L. S. J. U. Type collection); from Loc. 152 (L. S. J. U.) 8 miles up Sylvia Creek, Montesano, Washington; H. Hannibal collector. Montesano, Miocene.

The body whorl with 4 angles each marked by a heavy encircling cord distinguish this species from other Chrysodomes.

Chrysodomus hannibali occurs at the type locality with *Buccinum jordani* Hertlein.

This species is named in honor of Mr. Harold Hannibal whose work has added valuable information to the knowledge of west coast stratigraphy.

Pecten (Chlamys) hodgei Hertlein, new species

Plate 4, figures 1, 2.

Shell of medium size, higher than long, slightly compressed, equilateral. Right valve ornamented by over 19 radiating ribs which are largely bifid and often have a small riblet on each side of the large ribs, the ribs toward the margins, become finer, interspaces somewhat rounded, showing very fine pitted surfaces, sculptured by a small intercalary riblet, ribs and riblets bearing fine, scattered, sharp, imbricating spines; sides of valve nearly straight, ventral margin regularly rounded; ears unequal, the anterior much larger than the posterior, anterior ear ornamented by about 5 or 6 coarse, radiating riblets which are crossed by concentric lines of growth, byssal notch large; posterior ear small in proportion to the large anterior ear, ornamented by about 9 small, radiating riblets which are crossed by concentric lines of growth. The ornamentation of the left valve consists of alternating large and small ribs but the ribbing is much finer than on the right valve. Height 47 mm.; length 40 mm.; diameter of right valve approximately 8 mm.; length of hinge line of right valve 25 mm.; apical angle of right valve approximtaely 87°.

Type: Right valve No. 20 (L. S. J. U. Type collection); Paratype: left valve No. 21 (L. S. J. U. Type collection), from Loc. F-6 (L. S. J. U. Geol. Surv.), Coalinga Region, Sec. 20, T. 19 S, R. 15 E, California; F. P. Vickery and P. L. Henderson collectors. Santa Margarita, Miocene.

Pecten hodgei appears to be closely related to *P. halimensis* Makiyama from the Pliocene of Japan, but it differs in that it has less numerous ribs which are more distinctly bifid, than in the species described by Makiyama. From *P. opuntia* Dall, *P. hodgei* differs in having the ribs bifid and arranged in pairs, rather than numerous, closely but irregularly spaced, rounded, and not bifid; the margins of *P. opuntia* are rounded and not straight as in the present species. From *P. jordani* Arnold, *P. hodgei* differs in having more numerous, rounder ribs, which on the right valve become bifid much earlier in the growth of the shell. From *P. hericius* Gould, *P. hodgei* differs in

having less numerous ribs, narrower, less high, and generally finer, and the shell possesses straighter margins in the present species. From *P. egregius* Nomland, *P. hodgei* is distinguished by having more numerous ribs which are differently ornamented in the present species.

Pecten hodgei at the type locality is associated with *Ostrea titan* Conrad, *Pecten crassicardo* Conrad, *Pecten raymondi* Clark.

This species is named in honor of Dr. E. T. Hodge, professor of Geology at the University of Oregon.

Pecten (Pseudamusium) vancouverensis fernandoensis Hertlein, new subspecies

Plate 4, figures 6, 7.

Shell small, somewhat compressed, pearly. Right valve sculptured by numerous submicroscopic radiating ribs which are crossed by concentric lines forming crosshatched sculpture on the shell, at each intersection a tiny node is developed; the anterior ear is well developed and ornamented by about 5 or 6 radiating ribs crossed by concentric lines of growth, posterior ear ornamented by radiating riblets crossed by concentric lines of growth. Left valve with sculpture similar to that of right, the ears of the left valve are well developed and sculptured similar to that of the right valve. There are about 7 to 9 slight, concentric undulations which are more noticeable on the interior casts of the valves than on the exterior of the valves. Height 16 mm.; length 14 mm.; diameter of left valve approximately 3 mm.; length of hinge line of left valve approximately 10 mm.; apical angle of left valve approximately 90°.

This species attains a size of 20 mm. in height and 20 mm. in length.

Type: Left valve No. 16 (L. S. J. U. Type collection), from one-fourth mile south of Taylor well No. 1, and one and one-half miles north of Ventura (on Ventura River) California; A. W. Ambrose collector, Fernando Pliocene; *Paratype*: Right valve, No. 17, (L. S. J. U. Type collection) from Loc. 155 (L. S. J. U.) drill core from depth of 2,800 feet, about 4,500 feet northwest of Signal Hill, 500 feet east of Orange Avenue and 750 feet north of Willow Street, Long Beach, California. Lower Fernando, Lower Pliocene.

Pecten vancouverensis fernandoensis Hertlein is distinguished from *P. vancouverensis* Whiteaves, by more distinct crosshatched sculpture and usually larger size. *P vancouverensis fernandoensis* is distinguished from *P. vancouverensis sanjuanensis* Clark, by finer sculpture and larger size in the present species. *P. vancouverensis fernandoensis* differs from *P. pedroanus* Trask, in its characteristic crosshatched sculpture. *P. vancouverensis fernandoensis* differs from *P. randolphi* var. *tillamookensis* Arnold, in that the present species has small nodes developed at the intersection of the crosshatched sculpture, while the variety described by Arnold has finer striae ornamentation on the valves.

Leland Stanford Junior University.

Plate 3.

Fig. 1. *Uptonia silviesi* Hertlein, new species, approximately four-fifths natural size; type, No. 99 (L. S. J. U. Type Coll.) from Loc. 27 (L. S. J. U.), dark red sandstone, Section 7, T. 20 S., R. 30 E., Tim Donovan's ranch near Silvies River, 18 miles north of Burns in Harney County, Oregon. Charmouthian, Middle Lower Jurassic.

Fig. 2. *Uptonia silviesi* Hertlein, new species, approximately natural size; ventral view of same specimen as Fig. 1.

Fig. 3. *Buccinum jordani* Hertlein, new species, approximately natural size; type No. 130 (L. S. J. U. Type Coll.) from Loc. 152 (L. S. J. U.) 8 miles up Sylvia Creek, Montesano, Washington; Montesano, Miocene.

Fig. 4. *Chrysodomus hannibali* Hertlein, new species, approximately natural size; type No. 129 (L. S. J. U. Type Coll.) from Loc. 152 (L. S. J. U.), 8 miles up Sylvia Creek, Montesano, Washington; Montesano, Miocene.

Fig. 5. *Uptonia silviesi* Hertlein, new species, approximately natural size; cross-section of largest whorl of type specimen.

Plate 4.

Fig. 1. *Pecten (Chlamys) hodgei* Hertlein, new species, approximately five-sixths natural size; paratype, left valve, No. 21 (L. S. J. U. Type Coll.) from Loc. F-6 (L. S. J. U. Geol. Surv. Coalinga Region), Sec. 20, T. 19 S., R. 15 E., California; Santa Margarita, Upper Miocene.

Fig. 2. *Pecten (Chlamys) hodgei* Hertlein, new species, approximately five-sixths natural size; type, right valve No. 20 (L. S. J. U. Type Coll.) from same Loc. as Fig. 1.

Fig. 3. *Pecten (Patinopecten) kernensis* Hertlein, new species, approximately natural size; type, right valve, No. 128 (L. S. J. U. Type Coll.) from Loc. 150 (L. S. J. U.), Pyramid Hill, 3 miles northwest of Mouth of Kern River Canyon, Kern County, California; Monterey, Miocene.

Fig. 4. *Pecten (Pecten) hawleyi* Hertlein, new species, approximately natural size; paratype, right valve, No. 22 (L. S. J. U. Type Coll.) from Loc. (L. S. J. U. Geol. Surv. Loc. 860) upper beds of the Vaqueros sandstones, Santa Inez mountains, Santa Barbara County, California; Vaqueros, Lower Miocene.

Fig. 5. *Pecten (Pecten) hawleyi* Hertlein, new species, approximately natural size; type left valve, No. 19 (L. S. J. U. Type Coll.) from same Loc. as Fig. 4.

Fig. 6. *Pecten vancouverensis fernandonesis* Hertlein, new subspecies, approximately five-sixths natural size; paratype, right valve, No. 17 (L. S. J. U. Type Coll.) from drill core from depth of 2,800 feet, about 4,500 feet northwest of Signal Hill, 500 feet east of Orange Avenue and 750 feet north of Willow Street, Long Beach, California; Fernando, Lower Pliocene.

Fig. 7. *Pecten vancouverensis fernandoensis* Hertlein, new subspecies, approximately five-sixths satural size; type, left valve, No. 16 (L. S. J. U. Type Coll.) from Loc. 155 (L. S. J. U.) one-fourth miles south of Taylor well No. 1, and one and one-half miles north of Ventura (on Ventura River), California; Fernando, Lower Pliocene.

Fig. 8. *Pecten (Amusium) condoni* Hertlein, new species, approximately five-sixths natural size; paratype, left valve, No. 18 (L. S. J. U. Type Coll.) from Loc. 148 (L. S. J. U.=N. P. 44) at dam No. 35 West Wishkah River, Washington, Montesano, Miocene.

Fig. 9. *Pecten (Amusium) condoni* Hertlein, new species, approximately five-sixths natural size; type, No. 15 (L. S. J. U. Type Coll.) Loc. same as Fig. 8. Montesano, Miocene.

Plate 3.

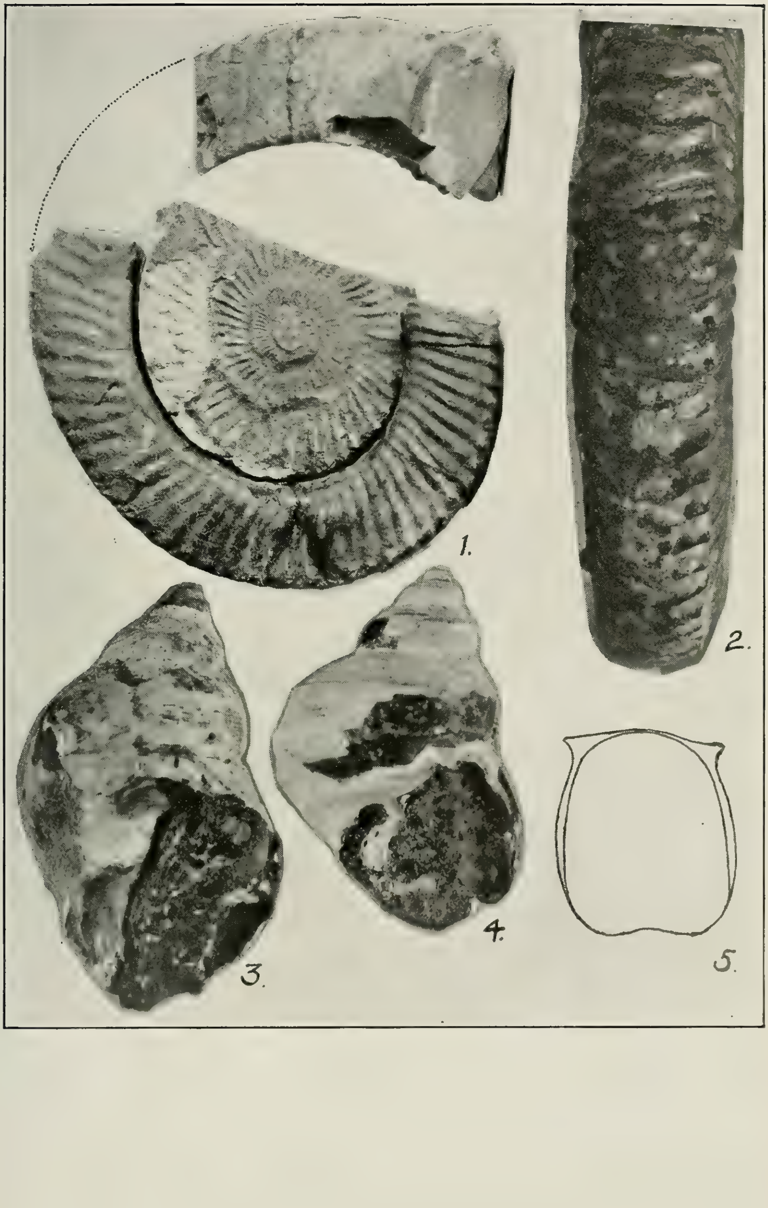
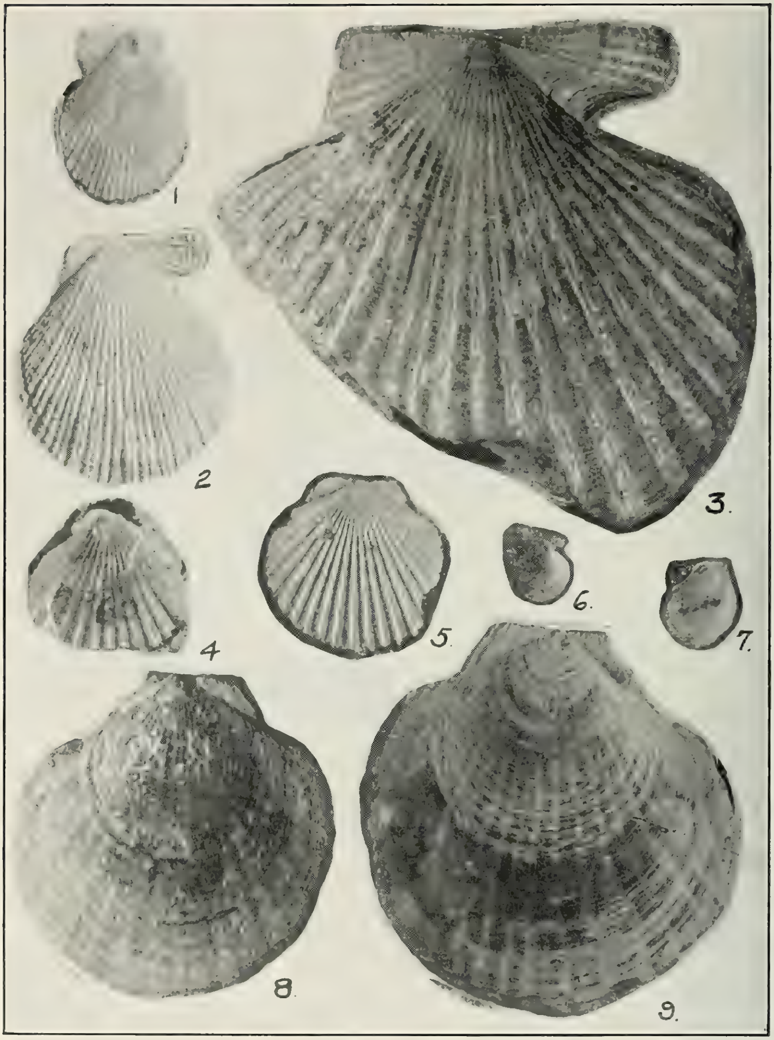


Plate 4.



SOUTHERN CALIFORNIA PLANT NOTES—III*

PHILIP A. MUNZ

Unless otherwise indicated all specimens cited in this paper are in the Herbarium of Pomona College, Claremont, California.

Polystichum mohrioides (Bory) Presl, var. **scopulinum** (D. C. Eaton) Fernald. Rhodora 26:89. 1924.

Polystichum scopulinum (D. C. Eaton) Maxon. Fern. Bull. 8:29. 1900.

To the two stations given by Munz & Johnston (Am. Fern Jour. 12:102. 1922) can be added a third one: Bluff Lake, San Bernardino Mts., *Johnston, July* 5, 1924, at 7,600 ft. alt.

Woodsia scopulina D. C. Eaton. Can. Nat. II, 12:90. 1865.

On August 24, 1922 this fern was collected with *W. oregana* D. C. Eaton about rocks and ledges at Dollar Lake, San Bernardino Mts., at 9,250 ft. alt., and, the two species not being distinguished, was distributed as *oregana, Munz* 6237, (Munz & Johnston, Am. Fern Jour. 12:74. 1922). This is the first collection of *W. scopulina* from Southern California. In this connection it may be stated that the report of *W. oregana* from near Rock Creek, San Gabriel Mts., (Davidson & Moxley, Fl. So. Calif., 15. 1923) is based on specimens, collected by Hasse & Davidson in 1906, of *Cystopteris fragilis* (L.) Bernh., a species which simulates *Woodsia* when it grows about rock-crevices on dry slopes, but which can of course be distinguished by its hooded indusium.

Botrychium Lunaria (L.) Swartz. Schrad. Jour. Bot. 2:110. 1800.

Reported from the San Antonio Mts. by Munz & Johnston (Am. Fern Jour. 12:119. 1922), where it grows in the Coldwater Fork of Lytle Creek. This undoubted material of *B. Lunaria* was referred to *B. simplex* E. Hitch. by Davidson & Moxley (Fl. So. Calif., 14, 1923). *B. Lunaria* can now also be reported from the San Bernardino Mts.: South Fork of the Santa Ana River, at 7,500-8,500 ft. alt., *Munz* 6164a (included with *B. simplex* in *Munz* 6164, Am. Fern Jour. 12:120. 1922); Lost Creek, at 9,400 ft., *Munz & Johnson* 8568; and South Fork of Mission Creek, at 8,500 ft., *Munz & Johnston* 8545.

A new station for *B. simplex* in the same range is Bluff Lake, 7,500 ft., *Johnston, July* 5, 1924.

Selaginella asprella Maxon. Smithson. Mis. Col. 72:6. 1920.

Heretofore known from the San Gabriel, San Bernardino, and San Jacinto Mts. (Munz & Johnston, Am. Fern Jour. 13:2. 1923). On Sept. 7, 1923 it was collected at 5,600 ft. alt. on a dry rocky ridge of Santiago Peak, Santa Ana Mts., Orange Co., *Munz* 7744; and on May 16, 1925 about rocks near the summit of Monument Peak, Laguna Mts., San Diego Co., at about the same elevation, *Munz* 9683.

Scirpus nanus Spreng. Pug. 1:4. 1815.

Jepson (Fl. Calif., 199. 1922) writes: "California material has been referred here (Cucamonga, acc. Pac. R. Rep. 4:152; Honey Lake Valley, *Davy* 3290), but the specimens are too young for certain determination." The occurrence in California is questioned also by Britton (Abrams, Ill. Fl. Pac. States 1:270. 1923). A collection of undoubted material was made at about 7,000 ft. alt. on the alkaline shore of Baldwin Lake, San Bernardino Mts., *Johnston, Sept.* 1, 1924, which has been identified by Fernald and Johnston at the Gray Herbarium.

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*The second paper of this series appeared in the Bull. So. Calif. Acad. 23:127-132. 1924.

Carex brevipes W. Boott. in S. Wats. Bot. Calif. 2:246. 1880.

Reported from the San Antonio Mts. (Johnston, Pl. World 22:82. 1919, Mackenzie, Erythea 8:55. 1922 and in Jeps. Fl. Calif., 227. 1922). Abundant also in the San Bernardino Mts. on dry slopes under pines: Bluff Lake at 7,600 ft. alt., *Johnston, July* 5, 1924; seen but not collected on dry slopes near Barton Flats, July 13, 1924 by Munz & Johnston.

Chenopodium glaucum L. Sp. Pl., 220. 1753.

Common on alkaline flats along shore of Baldwin Lake in the San Bernardino Mts., *Johnston, July* 5, 1924 and *Sept.* 2, 1924. The only other report of the occurrence of this species in California that I have been able to find in the literature is the Suisun Marshes (Greene, Fl. Fran., 167. 1895; Jeps., Fl. Calif., 431. 1914).

Lewisia brachycalyx Engelm., Gray, Proc. Am. Acad. 7:400. 1868.

In addition to the well known stations in Bear Valley of the San Bernardino Mts. (Robinson, Syn. Fl. 1, pt. 1:267. 1897; Jeps. Fl. Calif., 479. 1914; Parish, Pl. World 20:212. 1917), this species can be recorded from Cuyamaca Lake, San Diego Co., where two plants were collected on May 11, 1924, *Munz & McNeil* 8128. On May 18, 1925 abundant material with large purplish-veined flowers was collected by F. W. Peirson and myself in moist open places on gentle slopes near the lake, *Munz* 9760.

Lewisia nevadensis (Gray) Robinson, Syn. Fl. 1, pt. 1:268. 1897.

Lewisia bernardina Davidson. Bull. So. Calif. Acad. 20:51. 1921.

As suggested by Robinson, l. c., and Davidson, l. c., this species is locally abundant in the San Bernardino Mts., growing in Bear Valley about moist meadows with *L. brachycalyx*, as at "two miles east of Bluff Lake," 7,500 ft., *Munz* 5614, and Bluff Lake, *Munz* 8171. It can be reported also from Mt. Piños, Ventura Co., where a collection was made in a cienega at 8,400 ft. alt., June 11, 1923, *Munz* 7022.

Arenaria saxosa Gray. Pl. Wright 2:18. 1853.

A single plant, *Hall* 7672, was collected in the South Fork Meadows on the San Bernardino Mts. (Hall, Zoe 5:264. 1908, reported as 7673; Jeps., Fl. Calif., 488. 1914). It is by no means an uncommon plant on half-dry slopes in the canyons of the main San Bernardino range, as witnessed by the following collections: So. Fork of Santa Ana River, 6,300 ft., *Peirson in* 1922, *Munz* 6152, and at 7,800 ft., *Munz* 6168; Lost Creek, at 6,600 ft., *Munz & Johnston* 8557; Vivian Creek, at 7,200 ft., *Munz* 7623.

Arenaria serpyllifolia L. Sp. Pl. 423. 1753.

Reported from Claremont by Parish (Bull. So. Calif. Acad. 17:64. 1918 and 19:16. 1920). Collected May 27, 1924 at Colby's Ranch, San Gabriel Mts., at 3,200 ft. alt., *Peirson* 4622, where it is abundant along ditches.

Stellaria crispa C. & S. Linnaea 1:51. 1826.

Reported by Hall from Round Valley, San Jacinto Mts. (Univ. Calif. Pub. Bot. 1:79. 1902), but according to Jepson (Fl. Calif., 485. 1914), it occurs in California only in the Northern Coast Ranges. The following collections have been checked with material at the Gray Herbarium and are to be referred to *S. crispa*: Fish Creek, San Bernardino Mts., at 7,600 ft. in shade of willows in a cienega, *Munz & Johnston* 8541; South Fork of the Santa Ana, in a wet meadow at 8,500 ft., *Munz* 6171; High Creek, at 9,100 ft. on wet banks, *Munz* 7595. In the San Jacinto Mts., Deer Springs, meadow at 8,200 ft., *Munz & Johnston* 8737; Tamarack Valley, near stream at 9,200 ft.,

Jaeger 1041; Round Valley, base of trees in wet meadow, *Munz* 6394; and Tahquitz Valley, *Mrs. Wilder* 239. While I have not seen the specimens of *S. borealis* or its var. *Bongardiana* Fernald cited by Jepson, l. c., from Southern California and by Parish (Zoe 4:162. 1893 & Pl. World 20:213. 1917), I suspect that they belong largely to the same species as the plants which I am referring to *S. crispa*. What material I have seen from our southern mountains certainly does not check with Fernald's description of *S. borealis* and the variety (Rhodora 16:150. 1914).

Lesquerella Kingii Wats. Proc. Am. Acad. 23:251. 1888.

The distribution for this species as given by Payson (Ann. Mo. Bot. Gard. 8:216. 1921) includes Telescope Peak, Panamint Mts. as the only California locality. Material kindly determined by Payson as belonging to this species was collected in flower at the east end of the Bear Lake, San Bernardino Mts. on May 16, 1924, *Peirson* 4600, and in fruit *Johnston, July* 6, 1924. This is undoubtedly the *L. Palmeri* Wats. of Parish (Pl. World 21:220. 1918) and his *Lesquerella sp.* (Pl. World 20:215. 1917).

Cleome serrulata Pursh. Fl. Am. Sept., 441. 1814.

Reported from Barstow by Parish (Bull. So. Calif. Acad. 14:15. 1915 and 19:19. 1920). A single plant was found April 20, 1924 in a recently cleared field about one mile north of Claremont, Los Angeles Co., *Munz & Estes* 8152.

Saxifraga arguta D. Don. Trans. Linn. Soc. 13:356. 1822.

Saxifraga punctata of authors generally, not *S. punctata* L.

Reported long ago from Dry Lake, San Bernardino Mts., at 9,000 ft. alt., *Mrs. Wilder, June* 1904 (Parish, Bot. Gaz. 38:460. 1904). Not collected in Southern California again until the summer of 1924 when it was found to be common locally on wet banks of Fish Creek, San Bernardino Mts., at 8,200 ft. alt., *Munz & Johnston* 8490 and on Lost Creek, 7,500 ft., *Munz & Johnston* 8604.

Philadelphus pumilus Rydb. No. Am. Fl. 22:173. 1905.

Philadelphus serpyllifolius Gray of Hall, Univ. Calif. Pub. Bot. 1: 83. 1902.

In the San Jacinto Mts. this plant has been known only from the Round Valley side, Hall. l. c., & *Jaeger* 1015 (Pomona, Univ. Calif., Herb.). It occurs also in Dark Canyon on rocky ledges at 7,500 ft. alt., *Munz & Johnston* 8738. The flowers are pure white, not ochroleucous as claimed by Rydb, l. c.

Euonymus Parishii Trelease, Syn. Fl. 1 pt. 1:397. 1897 and Trans. St. Louis Acad. 5:354. 1899.

This shrub has been known in the San Jacinto Mts., from a canyon "opening into Strawberry Valley from the east" at about 6,000 ft. alt. (Parish, Muhlenbergia 7:77. 1911; Hall, Univ. Calif. Pub. Bot. 1:93. 1902). On May 18, 1924 it was collected on a springy hillside in a small canyon north of Dark Canyon and about 18 miles from Banning on the Banning-Idyllwild Road, *Munz* 8148. On July 27, 1924 it was found to be frequent along the stream in Dark Canyon from 5,300 to 6,500 ft., *Munz & Johnston* 8790. It is known also from several collections in Palomar and Cuyamaca Mts., (Parish, l. c. & *Munz* 9798).

Pyrola asarifolia Michx. Var. **incarnata** (Fisch.) Fernald. Rhodora 6:178. 1904.

The report of the occurrence of this species on Vivian Creek, San Bernardino Mts. (Munz, Bull. So. Calif. Acad. 23:129. 1924) can be supplemented by that of three additional collections in the same range but on the north side of San Gorgonio Peak rather than the south: Fish Creek, at 7,600 ft., *Munz & Johnston* 8540, locally abundant in shade of willows in wet meadow; Lost Creek, at 7,400 ft., *Munz & Johnston* 8566, on mossy banks; and East Fork of Lost Creek at 9,300 ft., *Munz & Johnston* 8582, where common under willows. *Pyrola minor* L. (Munz, Bull. So. Calif. Acad. 23:130. 1924) was also collected among the east fork of Lost Creek, at 9,000 to 9,200 ft., *Munz & Johnston* 8583, in a shaded canyon bottom.

Gilia maculata Parish. Bull. Torrey Bot. Club 19:93. 1892.

Linanthus maculatus Milliken, Univ. Calif. Pub. Bot. 2:55. 1904.

Two collections of this species have been known, both from near Palm Springs (Agua Caliente): one by W. G. Wright in 1889 and one by Mrs. Wilder (Parish, Muhlenbergia 3:124. 1907; neither of these collections is represented at Pomona). On April 20, 1924 the species was found in a sandy wash at Coyote Holes on the southern edge of the Mohave Desert in the Little San Bernardino Mts., *Munz* 7941. The small plants scarcely exceeded 3-4 cm. in length, were depressed, and bore whitish flowers with pink inner markings.

Lappula echinata Gilibert. Fl. Lithuan. 1:25. 1781.

Collected as an adventive in a garden at Upland, *Johnston, July* 18, 1924. Not previously reported from the state.

Plagiobothrys catalinensis (Gray) Macbr. Proc. Am. Acad. 51. 546. 1916.

Plagiobothrys arizonicus var. *catalinensis* Gray, Synop. Fl. ed. 2, 2, pt. 1:431. 1886.

Known previously only from Catalina Island (Johnston, Contr. Gray Herb., N. S. 68:70. 1923). Collected April 10, 1923 on San Clemente Island, *Munz* 6705, where it grew on gentle grassy slopes in the center of the island. Determined by Johnston.

Plagiobothrys Jonesii Gray. Synop. Fl. ed. 2, 2, pt. 1:430. 1886.

Previously known only from collections in extreme eastern California: near Needles, *Jones in* 1884, *Munz & Harwood* 3616; from the Panamints (Coville, Contr. U. S. Nat. Herb. 4:164. 1893); and Inyo Co. (Brandegee, acc. to Johnston, in lit.). A considerable extension of range is therefore represented by a collection made in a wash coming from the Newberry Mts., about seven miles east of Daggett, San Bernardino Co., April 6, 1924, *Munz & Keck* 7850.

Mentha Pulegium L. Sp. Pl. 557. 1753.

This species has been known in the central and northern portions of the state of California. It can now be reported from Mesa Grande, San Diego Co., at 2,300 ft. alt., *Mary F. Spencer* 2353.

Monardella macrantha Gray. Proc. Am. Acad. 11:100. 1876.

At the time of Johnston's paper on the San Antonio Mts. (Pl. World 22:71-90, 105-122. 1919) this species was not known from the range, though it had been reported from the more western part of the San Gabriel Mts. (Grinnell, Lorquinia 2:13. 1917). It has now been found near the head of Evey Canyon, a branch on the west side of San Antonio Canyon, *Johnston, Aug.* 13, 1924.

Artemisia tridentata subsp.* **nova** (Nelson) Hall & Clements, Carneg. Inst. Pub. 326:137. 1923.

Artemisia nova Nelson. Bull. Torrey Bot. Club 27:274. 1900.

Reported by Hall & Clements, l. c., from Inyo Co. Collected at head of Johnson Grade near Doble, San Bernardino Mts., where it is common on open stony ridges at 6,800 ft. alt. and grows 1-2 ft. tall, *Johnston, Sept.* 1, 1924.

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*While I do not care to use the subspecies category instead of the variety, I do so here and in the next case, simply because this hardly seems the place to make the necessary new combinations.

Aster frondosus (Nutt.) T. & G. Fl. No. Am. 2:165. 1841.

Brachyactis frondosa Gray, Proc. Am. Acad. 8:647. 1873.

The first station to be reported from Southern California is Baldwin Lake, San Bernardino Mts., where the species was collected May 15, 1924 on the moist alkaline shore, *Peirson* 4595; and by *Johnston, July* 5, 1924.

Chrysothamnus Parryi subsp. **asper** (Greene) Hall & Clements, Carneg. Inst. Pub. 326:200. 1923.

Chrysothamnus asper Greene, Leaflets Bot. Obs. 1:80. 1904.

Reported by Hall and Clements from as far south as Alamo Mt., Ventura Co. Collected between Arrastre Flats and Saragosa Spring, San Bernardino Mts., at 7,500 ft. alt., *I. M. Johnston, Sept.* 1, 1924. It is there locally frequent under pines as a low lax spreading shrub, 0.5-1.5 ft. tall.

Erigeron lonchophyllus Hook., Fl. Bor. Am. 1:18. 1834.

I have found no reference to the occurrence of this species in Southern California. The following collections can be reported, all from the San Bernardino Mts.: Big Meadows, *Hall* 7592, in 1906 (Univ. Calif. Herb., distributed as *E. divergens*), *Munz & Johnston* 8509, at 7,000 ft., July 14, 1924, and *Munz & Johnston* 8656, at 7,100 ft., July 16, 1924; South Fork of Santa Ana River, at 7,600 ft., Aug. 22, 1922, *Munz* 6172.

Lygodesmia spinosa Nutt. Trans. Am. Phil. Soc. N. S. 7:444. 1841.

Previously known in our region only from the San Gabriel Mts., (Munz, Bull. So. Calif. Acad. 23:132. 1924). It grows also on the desert slopes of the San Bernardino Mts., where it was collected at 7,000 ft. alt., on a slope of Gold Mt. near Baldwin Lake, *I. M. Johnston, July* 5, 1924.

DESCRIPTION OF A NEW PECTEN FROM VENEZUELA, S. A.

By P. I. AGUERREVERE
Stanford University

Pecten (Lyropecten) arnoldi, n. sp.

Description: Shell slightly broader than high, subequilateral, subequivalve, medium thickness, submargins with fine, close, undulating growth lines; base rounded; sides slightly curving out near the ends. Right valve slightly nodose in the first stages of growth; with nine or ten broad flat ribs with three or four flat riblets; interspaces slightly narrower than the ribs with one prominent riblet in the center and a minor one on either side, the interspacial riblets being much more prominent than those on the ribs; the whole surface is covered with undulating concentric lines of growth which almost obliterate all other sculpture near the periphery. Anterior ear less than one and one tenth times as large as the posterior, with four radiating riblets; the whole ear is covered with fine, close, growth lines becoming stronger towards the end; byssal notch not very prominent; byssal area with concentric area of growth only. Posterior ear squarish, somewhat rounded in the rear, with very faint or no riblets, but with a stronger concentric sculpture than the anterior. Umbo rather sharply pointed ending at the hinge line. Left valve resembling the right except that it is slightly more nodose, the ribs are narrower, and the interspaces are wider in proportion. The left valve is slightly less arched than the right.

Dimensions of the type: altitude 210 mm.; longitude 218 mm.; hinge line 115 mm.; diameter 95 mm.

Pecten nodosus Linnaeus of Margarita Island seems to be a descendant of *Pecten arnoldi*. It retains the shape and the number of ribs, and in a general way the sculpture of *P. arnoldi* but it is much more nodose. The riblets of *P. nodosus* are more abundant and more prominent than on *P. arnoldi;* however, the riblets in the interspaces are still only three or four and are more prominent than those on the ribs. The whole shell of *P. nodosus* has very fine and inconspicuous lines of growth while *P. arnoldi* has very conspicuous growth lines. The anterior ear of *P. nodosus* still keeps the ribs found in *P. arnoldi*, but it has besides a number of less prominent ones. The byssal area and the posterior ear of *P. nodosus* have both radiating riblets and concentric lines, the former being more prominent than the latter; while in *P. arnoldi* the riblets are very faint or do not exist at all.

Plate 5.

Pecten arnoldi Aguerrevere. Type specimen. Right valve. Slightly reduced.

Pecten subnodosus Sowerby of the Pacific Coast resembles *P. arnoldi* in the general shape of the shell and the number of ribs; however, the sculpture of *P. subnodosus* consists of fine numerous riblets equally distributed on the ribs and the interspaces, with few, widely separated lines of growth. The byssal hinge and the anterior ear of *P. subnodosus* are equally covered with many minor riblets; while *P. arnoldi* has only concentric growth lines on the byssal area and four riblets with concentric lines on the anterior ear. The posterior ear of *P. subnodosus* has radiating riblets; that of *P. arnoldi* has concentric sculpture. In its youth, *P. subnodosus* resembles more *P. arnoldi* than in its maturity; the interspacial riblets are then more pronounced than those on the ribs; the anterior ear has only four radiating riblets with concentric sculpture and the byssal area has only concentric sculpture.

The type specimen of *Pecten arnoldi* was found 1 and ¾ miles east of the Castle of Cumana, State of Sucre, Venezuela, S. A.

This, the largest known species of Pecten, is very appropriately named in honor of Ralph Arnold, in recognition of his contributions to our knowledge of the Pecten group, and to the stratigraphy of the Tertiary in California and Venezuela.

Horizon: probably Miocene.

P. I. AGUERREVERE

Stanford University.

In Memoriam

William Henry Knight, one of the founders and Past-President of the Southern California Academy of Sciences, passed to the great mystery May 12th, 1925. He was a veteran in the cause of Science and Liberal Culture, a painstaking student of Astronomy, with a broad interest in every branch of knowledge, a facile and lucid writer on many subjects of vital interest. He was founder and for a number of years President of the Los Angeles Astronomical Society. Before taking up his residence in Southern California he was long identified with the California Academy of Science at San Francisco, and in that capacity had the honor of naming Lake Tahoe and suggesting to James Lick the bequest which founded the Lick Observatory on Mount Hamilton. Mr. Knight lived to the ripe age of ninety years and maintained his mental activity to the last, being scheduled for an address before the Proximo Club within ten days of the time if his demise as the result of an automobile accident.

This momento is made and adopted by the Southern California Academy of Sciences, and ordered spread upon the minutes of the Academy in token of its high appreciation of Mr. Knight's beautiful life and character.

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■ ■

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"	14,	"	1.	January	1915	.75
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"	16,	"	1.	January,	1917	.75
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"	17,	"	2.	July,	1918	.75
"	18,	"	1.	January,	1919	1.00
"	18,	"	2.	July,	1919	.75
"	19,	"	1.	January,	1920	.25
"	19,	"	4.	October,	1920	.25
"	20,	"	1.	April,	1921	.25
"	20,	"	2.	August,	1921	.25
"	20,	"	3.	December,	1921	.25
"	21,	"	1.	March,	1922	.25
"	21,	"	2.	October,	1922	.25
"	22,	"	1.	March,	1923	.25
"	22,	"	2.	July,	1923	.25
"	23,	"	1.	January,	1924	.25
"	23,	"	2.	March,	1924	.25
"	23,	"	3.	May,	1924	.25
"	23,	"	4.	July,	1924	.25
"	23,	"	5.	September,	1924	.25
"	23,	"	6.	November,	1924	.25
"	24,	"	1.	January,	1925	.25
"	24,	"	2.	May,	1925	.25

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DR. JOHN A. COMSTOCK, *Secretary*

Southern California Academy of Sciences, Southwest Museum
Los Angeles, California.

BULLETIN OF THE

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LOS ANGELES, CALIFORNIA

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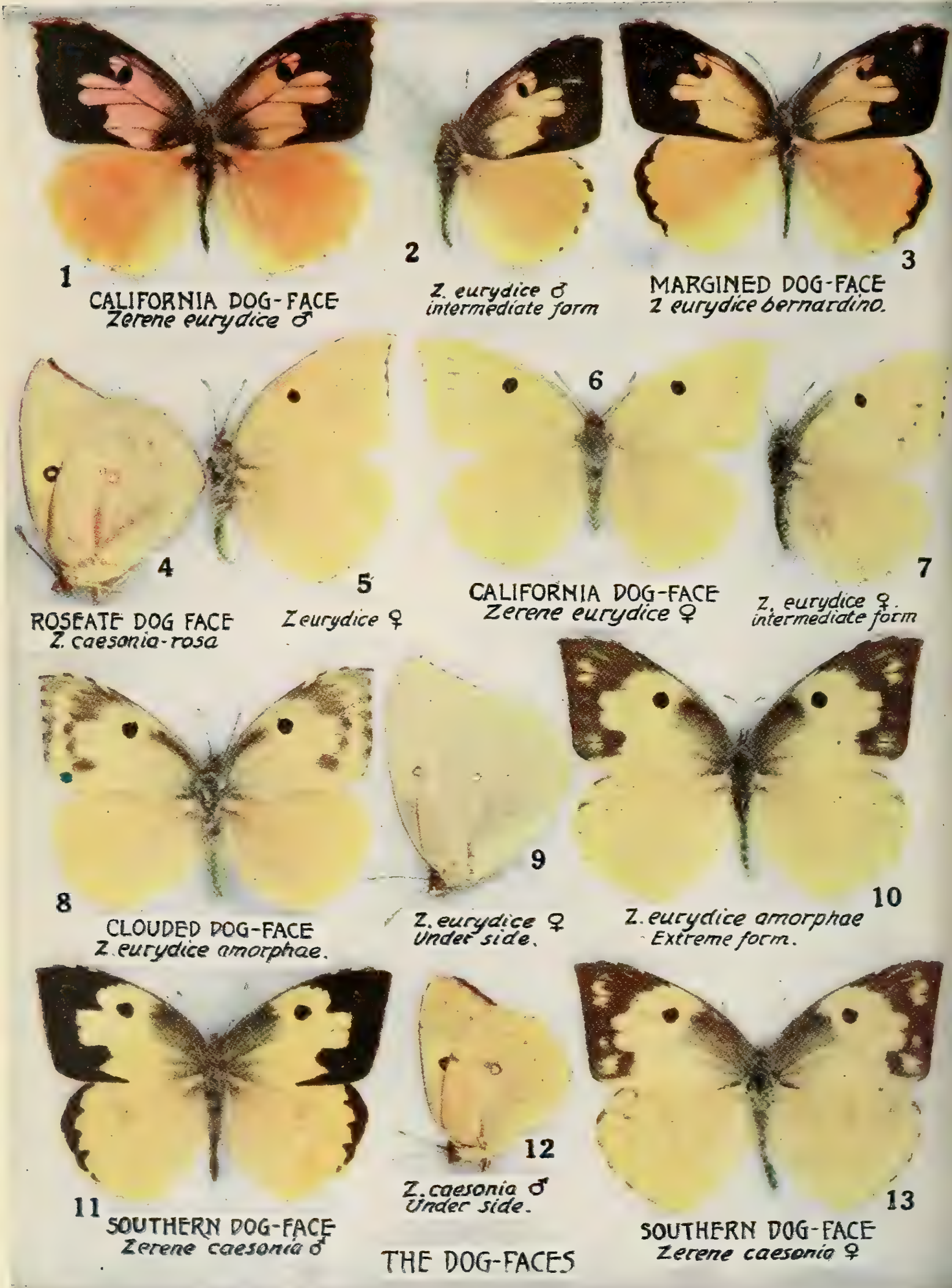

All figures slightly reduced.

BUTTERFLIES OF CALIFORNIA—(Continued)

DR. JOHN A. COMSTOCK

Genus CATOPSILIA. Hübner

The Sulphurs

The CLOUDLESS SULPHUR is represented in California by a race which we have called the SENNA SULPHUR (Catopsilia eubule sennae Linn.) This brightly colored and agile butterfly is a familiar sight as it dodges through the gardens of Southern California in search of the Cassias on which its larvae feed. On account of its rapid flight it is secured more readily by breeding.

The larvae may be taken feeding upon the leaves and blossoms of the several species of Cassia which have been introduced as ornamental shrubs in our parks and gardens,—and are also occasionally found on clover.

It is interesting to note the changes of color assumed by the caterpillar, which takes on an orange shade when indulging in the bright petals of the Cassia blossoms, and is a vivid green when feeding on the leaves.

An albinic female of this butterfly is rarely met with. This form was named **pallida** by Cockerell. Occasionally examples are found which show only a partial tendency toward albinism. One such specimen is figured in our plate 13 (Fig. 4), but the engraver has unfortunately made the figure more yellow than in the actual specimen. Plate 13 will be shown in the next issue of the Bulletin. It pictures both sexes of this interesting butterfly. The Senna Sulphur is on the wing from May to December, or until the first cold snap puts it out of commission. It must produce several broods, to account for its long season.

GENUS ZERENE Hübner.

The Dog-Faces

The **California Dog-face** (Zerene eurydice eurydice Bdv.) ranges from Mendocino County in the north to our southern border. The male of this species is one of our most beautiful butterflies. The violet-rose suffusion occurring on the fore-wing, in certain lights is difficult to portray, and must be seen in the lving specimen to be fully appreciated. Several forms of this butterfly occur in California. The **Margined Dog-Face** (Zerene eurydice bernardino Edw.) is limited to the male sex, and is characterized by a black marginal band on the secondaries. The **Clouded Dog-Face** (Zerene eurydice amorphae Hy. Edw.) is a form of the female which shows a tendency toward the markings of the common eastern species Z. caesonia. All intergrades between this and the typical form occur, and occasionally specimens are found with such a marked intensification of the dark border as to be almost indistinguishable from Z. caesonia.

The food plant of the species is the false indigo or lead-plant (Amorpha californica). It is double brooded, with captures recorded from March to November.

Two aberrant forms of this butterfly have recently been described by Mr. Jeane Gunder, and may be distinguished as follows:

The **Pale Dog-Face** (Zerene eurydice newcombi) is characterized by a light yellow color in the place of the usual deep orange. It was named for Mr. Hal Newcomb.

The **Suffused Dog-Face** (Zerene eurydice fanniae) named for Mrs. Gunder, is an aberrant male in which a heavy black shading obscures the cell and forward portion of the forewing, thus obliterating the characteristic "dog-head."

The Southern Dog-Face (Zerene caesonia stoll) is relatively rare in California, and does not occur north of Los Angeles County. It flies with the former species and undoubtedly has the same food plant. In the eastern states, this butterfly produces a late fall brood which is beautifully suffused on the underside with a rich pink or rose. The **Roseate Dog-Face** (Zerene caesonia rosa, McNeill) has not been reported for our state, possibly on account of the mild climate, but a few specimens from Arizona show indications of this suffusion.

One of these specimens is figured on our plate XII (fig. 4). We picture it in order that lepidopterists may be on the lookout for it in our southern counties.

Plate XII, shown in this issue of the "Bulletin" gives adequate illustrations of our Dog-Faces, with most of the characteristic forms.

STUDIES IN PACIFIC COAST LEPIDOPTERA

(Continued)

DR. JOHN A. COMSTOCK

EIGHT NEW RACES, FORMS OR ABERRATIONS OF CALIFORNIA BUTTERFLIES

Drs. Barnes and McDunnough, in their CONTRIBUTIONS, Vol. 3, No. 2, have pointed out the advisability of holding the name *eryngii* for the race of *Caenonympha california,* without ocelli, occuring in the vicinity of Soda Springs, Siskiyou County, California. They have not, however, mentioned the fact that this race is seasonally dimorphic as with *C. california* and *galactinus.*

Henry Edward's original description of *eryngii* strongly indicates that he is dealing with the summer form—which is "wanting the black or dusky hairs at the base of the wings, the thorax and abdomen being concolorous." His comparison of the type with *galactinus,* in which the absence of this black powdering in the basal area is a constant feature, further strengthens this opinion. His types were collected in August when the yellow form is predominant.

We are safe in presuming therefore that *eryngii* refers to the late form, which leaves the white spring and early summer form without a designation. We propose for this the name *siskiyouensis,* and record it as follows:

Caenonympha california form **siskiyouensis,** form nov.

Expanse, ♂ 1 1/8 inches. ♀ same.

♂ **Superior surface,** primaries and secondaries, lustrous white, even on the fringes, (which in typical california are usually darker than the remainder of wing). A slight greyish powdering is noted on the basal area of the primaries, but is less noticeable on secondaries.

Inferior surface. Resembles typical *california,* the ground color being white with a liberal maculation of brownish grey. There is, however, a complete suppression of all ocelli. (One specimen shows a slight hint of one or two points, as white dots, but not the true ocellus with dark centers.) The dark band crossing the outer third of the primary is slightly more crenated than in the typical form.

♀ much the same as ♂.

It must be noted that these forms emerge at a relatively later period than is the case in the lowlands.

In other respects this form does not differ from typical california.

Types. ♂ holotype, Mt. Shasta, Calif., July 19, 1921. ♀ allotype, Shasta Retreat, Siskiyou Co., Calif., June 1-7. Coll. Barnes. Paratypes Nos. 1 and 2, Siskiyou Co., Calif., July 28, 1923. Nos. 3, 4, and 5, Shasta Retreat, Siskiyou Co., Calif., June 8-15. Coll. Barnes. The holotype and paratypes 1 and 2 in the collection of the Southwest Museum. Allotype, and paratypes, 3 to 5 in the collection of Dr. William Barnes.

Our color plate 18, figure 11 shows the superior surface of our ♂ holotype, and fig. 12, paratype No. 2.

In CONTRIBUTIONS, Vol. 3, No. 2, Drs. Barnes and McDunnough state that the type series of *Argynnis purpurascens* Hy. Edw. in the American Museum contains a ♂ of a form of *hydaspe* and ♀♀ of *zerene*, and they have appropriately restricted the type to the dark male from Soda Springs, Siskiyou County, California.

Both *hydaspe* and *zerene* show these dark northern forms. It seems to us inconsistent to apply the name *purpurascens* to forms of two different species within a genus, and we therefore propose to designate the purplish form of *zerene* as:

Argynnis zerene form **conchyliatus** form nov. naming it for the purple shell from which the royal purple dyes were made in the days of the Roman Empire.

Our figures 1 and 2 on color plate 25 give such accurate delineation of the under side of both sexes of this form, that a lengthy description is unnecessary. It is sufficient to state that the superior surface in both sexes is somewhat heavier marked than in the typical examples, and the inferior surfaces are more deeply overlaid with rich brown, in which a purplish sheen is detected. This purplish color is more marked in the female.

The buff band internal to submarginal silver lunules on inferior surface is markedly restricted. Both sexes are well silvered. Our figure 1 shows the under surface of ♂ holotype, and figure 2 the same aspect of ♀ allotype.

Types. ♂ holotype, Mt. Shasta, Calif., July 19, 1921. ♀ allotype, Northern California, no date, collected by Cottle. Paratypes Nos. 1 to 4, ♂♂ Shasta Co., Calif., June 4th to July 10th. Nos. 5 to 8, Shasta Retreat, Siskiyou Co. Calif., June 16 to July 15, Coll. Barnes. Paratypes Nos. 9 to 12, ♀♀ Shasta and Humboldt Counties, Calif., July 5 to August 11, 1923. Nos. 13 to 16, Shasta Retreat, Siskiyou Co., Calif., July 1 to August 23. Coll. Barnes.

Holotype, allotype, and paratypes Nos. 1 to 4 and 9 to 12 in the Southwest Museum Collection. Paratypes Nos. 5 to 8 and 13 to 16, in the collection of Dr. William Barnes, Decatur, Ill.

Dr. Oberthur's publication of Boisduval's types of *Argynnis hydaspe* (Etudes de Lepidopterologie Comparee, Fasc. IX, Part 2), convinces us that these were collected in the Sierran foothills at some point about midway of the species range within the state.

This species shows a tendency toward intensification of the dark colors and a widening of the black bands, in the northern limits of its range, the extreme of which finds expression in the form *rhodope*.

A reverse tendency is evidenced in its southern extension. We are indebted to Mr. W. H. Ireland for a series of specimens from the Greenhorn Mountains, which are the southernmost limit of its range.

These carry the 'lightening' to an extreme point, and give us a form which is worthy of special designation. For this form we propose the name:

Argynnis hydaspe form viridicornis form nov.
Expanse, ♂ 2 1/16 inches. ♀ 2¼ inches.

♂ **superior surface,** much as in typical *hydaspe* but the dark markings are reduced in intensity. Two fine marginal lines are apparent on primaries, which in the typical form tend to fuse as a wide marginal band. Internal to this is a row of seven lunules. In the typical form these are usually fused, thus enclosing 6 ovals, a feature that is particularly noticeable in Oberthur's type figure 2,200. Internal to this row of lunules is the usual row of six round spots. Medial to this is the usual irregular crenated band, but in our form this is reduced in width and is less indented than in the typical examples. The bars crossing cell are also restricted in width. The medial half of primaries is more nearly uniform in ground color with the remainder of the wing than is the case with the typical form. On the secondaries the principal difference lies in the reduction in width of the irregular band crossing the middle area of the wing. This is well brought out in our figure 4, color plate 25.

Inferior surface. This aspect of the butterfly is markedly different from the typical form, in the fact that the light buff shade is much increased, and is extended inward on the primaries to the cell, and also on the secondaries where it reaches the basal area.

The ovals and lunules (which in most of our Argynnids are silvered) are increased in area, and are of the usual creamy-buff shade.

Our figure 6 shows the under-side of the holotype ♂, figure 8, the same aspect of allotype ♀, all shown on color plate 25, to be subsequently run in the "Bulletin."

Types. Holotype ♂ Greenhorn Mountains, Calif., July, 1923, W. H. Ireland. Allotype ♀, same locality, date, and collector. 3 paratypes, all taken at the same place, on the same date, by Mr. Ireland. Two of these will be deposited in the Barnes collection. The remainder are in the collection of the Southwest Museum.

Mr. J. E. Cottle of San Francisco has loaned us an Argynnid which seems so radically different from any other member of the genus occurring in our state that I venture to describe it, notwithstanding the fact that at present it is a unique example.

Argynnis cottlei sp. nov.

♀ **superior surface,** primaries. Color and general markings somewhat as in *hippolyta*, but the dark spots and bands are relatively heavier. Fringes cream, except at ends of nervules where they are dark. The marginal lines, which in our examples of *hippolyta* are double, show in this specimen as a wide single band. Internal to this the usual row of 8 oval spots, creamy buff in color, shaded with black lunules on their inner edges. Internal to this the usual buff field, with 6 round dark spots superimposed on it. The usual dark crenated line internal to this field is heavier than in *hippolyta*, as are also the dark bands crossing the cell. The basal area is an even dark ferruginous.

Secondaries. Fringes as on primaries. Marginal lines fused near costa but separating into two narrow lines, which are clearly defined in the posterior portion of wing. Internal to this the usual row of 7 oval spots, lighter in shade than the ground color, and relatively larger than on other species. These are shaded internally by the usual dark lunules. Internal to this a wide band of creamy buff, darker in shade on its outer half, and crossed by the usual row of small round spots. Internal to this a wide crenated dark band. A heavy O in outer portion of cell. Basal area, dark ferruginous.

Inferior Surface. Somewhat resembling *irene*. All of the oval spots large, and entirely without a trace of silver scaling. The usual

crenated line across the center of primaries is wide and clearly defined. On the secondaries, the usual row of submarginal spots is destinctive, being formed of large ovals without a trace of the triangular effect common to most of our Argynnids. The buff band internal to these is narrow. The oval spots of the discal area are large, and are shaded internally by narrow black lines as in *irene*. Further description is unnecessary in view of the colored representation of this aspect of the species shown on our color plate 26, figure 2.

Thorax and abdomen, brown above, cream below.

Expanse. 1⅞ inches.

Type. ♀ near Alturas, Modoc Co., Calif. No date given. In the collection of Mr. J. E. Cottle, San Francisco.

This butterfly may prove to be an unsilvered aberrant form of *hippolyta* but it seems so distinct in many particulars that I list it for the present as a separate species.

The handsome aberration of *Argynnis zerene* which I have shown on color plate 26, figure 1, is so unique that I have ventured to name it for the noble mountain on which it was found. This region has, for some unknown reason, a profound effect on certain insects occurring in it. This is well illustrated in the case of *Pseudohazis eglanterina*. This beautiful moth is subject to some variation throughout its range, but in no other region have I seen such a marked tendency to aberrations as on Mt. Shasta. The majority of the specimens are heavily suffused (form *shastaensis* Behr) but examples occur which are of nearly a clear yellow. I have designated this specimen:—

Argynnis zerene ab. shastaensis aberr. nov.

Expanse. 2⅛ inches.

♂ **Superior surface,** primaries. Ground color a rich black. Fringes black opposite nervules, with narrow buff areas between. Marginal lines double but fused at nervules, enclosing 6 narrow elongate lines. Several irregular buff spots are scattered over the basal and discal areas. These are so clearly shown on our plate that no description is necessary.

Secondaries. Fringes, and marginal bands as on primaries. Internal thereto are six oval or irregular buff spots, largest at anal end. Remainder of wing nearly a solid black, except along inner margin where it is buff.

Inferior surface; primaries. Fringes, blackish-brown, except for a narrow buff area between each nervule. Suggestion of a double marginal brown band with buff shading in the inter-nervular area. Internal to this are 6 triangular or irregular creamy-buff spots on a dark brown background, the largest near apex, and the posterior paired. The fourth and fifth of these are shaded internally by elongate sagittate spots. The usual crenated black line crossing the middle of wing is so wide as to obscure most of this area. The cell is nearly filled in its outer two-thirds by black scales, and a narrow black line crosses the inner third, which is of a buff color.

Secondaries. No trace of silvering occurs, and the spots which usually bear this lustrous scaling are reduced in number and area. Fringes and marginal lines as on primaries. Seven oval or irregular submarginal cream colored spots, the first and last being mere points. Internal to this there is almost no trace of the usual buff area, but instead of this there is a rich, chocolate brown ground color. This becomes darker in the discal area and gradually shades to a light brown in the basal area. In the outer portion of the discal area, the usual 7 spots are reduced in area, and only five are defined with any degree of clarity. In the extra-basal area there are three spots, the center one being largest. These are margined or internally shaded

with black. Three irregular dashes of light buff occur in the inner basal area, the central one being about three times the area of the others.

Thorax and abdomen, dark brown above, creamy buff below.

Type. ♂ Mt. Shasta, Siskiyou Co. July.

Collection. J. E. Cottle.

Another remarkable aberration secured by Mr. Cottle is worthy of separate designation and I propose for it the following name.

Argynnis hydaspe ab. **caliginosa** aberr. nov.

Expanse. 2⅜ inches.

♂ **Superior surface,** primaries.

Ground color a rich black. Fringes black with a few brown scales between nervules. Wide black marginal band, with a few dark brown scales between nervules. Six small round submarginal ferruginous spots on a black ground, and a slight powdering of brown scales along costa near apex and base. Six black, round spots in a row across limbal area, narrowly and irregularly margined with ferruginous, giving the appearance of ocelli. Discal areal almost completely suffused with black, except for two quadrate light ferruginous spots at end of disc, and a powdering of lighter scales below the first submedian nervule. All of the nervules have a slight suggestion of lighter scaling through the discal area. Outer half of cell black, an elongate irregular spot centrally placed and narrowly edged with black on its inner margin. Basal area dark ferruginous.

Secondaries. Fringes as on primaries, but with a larger number of light scales. Double marginal black line fused at nervules. Seven submarginal ovals, those nearest costa more clearly defined, and the anal three reduced almost to narrow lines. Five or six round black spots acoss limbal area, partly surrounded by ferruginous, and tending to fuse at several points with the black submarginal lunules. Discal area solid black except for two poorly defined ferruginous spots centrally placed. Basal area darker than on primaries.

This aspect of the butterfly is clearly depicted in our figure 3 of plate 26.

Inferior surface, primaries.

Two narrow marginal black lines fused at nervules, and enclosing 7 elongate brown dashes. Internal thereto 6 buff triangles, the anterior being more clearly defined. There is a large amount of brown scaling throughout the apical area, and the light spots of the upper surface carry through with a slight increase of area. Otherwise the markings are much as on the superior surface, although the black is not of quite so deep a shade.

Secondaries. The submarginal stripes are lost, being replaced by a wide, brown band. Submarginal row of triangular spots buff, those in the radial interspaces being more clearly defined. These are margined wth blackish scales and a few of them are slightly invaded with these same scales, giving a suggestion of blue. Internal to this is a clear field of rich brown bordered on its discal edge by a row of 6 or 7 buff ovals. Only the one distal to the end of the cell is well defined and large. The others are suffused to a greater or less extent by black scaling. All are margined with black, heaviest on their basal edges. Internal to this is a field of rich brown, with five buff spots super-imposed. Only the outer three of these are clearly defined, and these are margined on their basal edges with black. There are a few irregularly placed scales of buff on the brown field of the basal area. The costa are narrowly margined with black.

Type. ♂ Modoc Co. Calif. No date.

Collection. Mr. J. E. Cottle.

Dr. Holland in his "Butterfly Book" suggests that *Argynnis atossa* may be an extreme variation of *A. adiaste.* We are confirmed in this belief by the receipt of a small series of specimens from Mr. Victor Clemence of Atascadero, Calif., of a form which is exactly intermediate in every respect between *atossa* and *adiaste.* We propose for this the name

Argynnis adiaste race **clemencei** race nov.

Expanse. ♂ 2 inches. ♀ 2⅛ inches.

Ground color, in the ♂ a light fulvous, whereas *atossa* is a clear, yellow brown and *adiaste* a rich, dark fulvous. ♀ a shade lighter. Our plate 28, figures 7 to 9 give such accurate delineation of this race that a detailed description in unnecessary. All of the spots and lines are disposed in a manner suggesting both *atossa* and *adiaste.* The marginal lines of primaries are double, but not heavily defined as in *adiaste*: the submarginal lunules are clearly defined, but not with the intensity of the last named species. The inferior surface, both as regards ground color, and the intensity of spots, etc., is exactly intermediate between the southern and northern races.

Holotype ♂, Atascadero, Calif., June 30, 1922. Victor L. Clemence. (Figured as No. 7.)

Allotype ♀ same date, locality and collector. (Fig. 9.)

Paratype No. 1. Same date, locality and collector. Fig. 8 underside. All figures shown on color plate 28.

I have collected in a number of localities in the coast range between Atascadero and the Tejon Mountains, and thus far have failed to secure connecting examples between these geographic races. It is possible that there remain, at the present time certain "islands" of survival of what at one time was a single species with an unbroken range throughout the coastal mountains.

The following arrangement seems justifiable for this group:

Argynnis adiaste Behr.
(a) Geog. race clemencei Comst.
(b) Geog. race atossa Edw.

Modoc County in north-eastern California is a district seldom visited by entomologists. The mountain ranges of this territory are frequently separated from neighboring ranges by wide stretches of desert or alkali flats. This would naturally tend to the production of distinct species or races of such butterflies as are characteristically alpine in habits. One such species has come to my attenton, which I take pleasure in naming for my friend, Mr. Jeane Gunder.

Argynnis gunderi sp. nov.

Expanse. ♂ 1⅛ inches. ♀ 1¼ inches.

♂ **Superior surface,** primaries. Fringes buff. Narrow submarginal line, thickened at junction with nervules. Internal to this a row of black crescents, becoming obsolete toward the apex. The usual row of 6 round spots crosses the limbal area. Fine dark scaling on the nervules gives this area a barred appearance. The usual crenated band crosses the outer part of discal area, but this is discontinuous at the nervules. An inverted capital P at outer end of cell, and three wavy lines crossing its center. Olive scaling suffuses the basal area. The ground color of both wings is a clear light buff.

Secondaries. Fringes and submarginal line as on primaries. Internal to this the usual row of lunules. A row of five round spots crosses the limbal area, the center one being smallest. The crenated line of the primaries is continued on the secondaries in much the same disjointed manner. An inverted C fills the outer portion of cell. Basal area as on primaries.

Inferior surface. Both wings show a clear yellow buff ground color which is of a lighter shade than in any other California Argynnid except *atossa.* The spots are all richly silvered.

Primaries. Apex clear yellow buff except for the silver spots. The submarginal crescents are reduced to 3 in the posterior portion; likewise the round spots of the limbal area are reduced to 3 or 4. The crenated line crossing the outer part of the discal area is reduced to 6 well defined quadrate spots. The dark markings in the region of the cell carry through to the under side.

Secondaries. There is no trace of any black or brown shading on this wing. A very delicate olive green scaling shows in relation to some of the silver spots, particularly on the inner edges of the submarginal row. The latter are triangular in form.

All of the above points are clearly brought out in our figures 4 to 6 of color plate 27, rendering further description unnecessary.

♀ Much the same as ♂ except that the dark markings are a little heavier, the ground color slightly richer, with the areas above the silver spots showing lighter on the superior surface, a slight suffusion of orange radiating from the basal area on under surface of primaries, and a little heavier olive scaling on the under side of secondaries.

Types: holotype ♂ Modoc Co., Cal., June 3, 1924. Allotype ♀ Modoc Co., Calif., July 7, 1924. Both coll. author. Paratype. Buck Creek, Modoc Co., July 21, 1922. Coll. Jean Gunder.

Gunderi may prove to be a geographic race of *snyderi*, which it somewhat resembles, but its smaller size, lighter ground color, and particularly the clear yellow-buff on under surface will serve to distinguish it.

Certain authors have treated *Argynnis atossa* as an unsilvered race of *A. semiramis.* From long acquaintance with these two species, I am convinced that *atossa* is a distinct species. It flies in a territory centering in the Tehachapi Mountains, whereas *semiramis* occurs in ranges to the south, such as the San Gabriel, San Bernardino and San Jacinto. Further confirmation of this rests in the fact that occasional specimens of *atossa* show various degrees of silvering, and these, even when fully silvered, show no resemblance to *semiramis.* I am showing, on plate 28, figure 6, one of these silvered examples, and propose for it the name

Argynnis atossa form **tejonica** form nov.

This is typical *atossa* except for the fact that the spots on the underside of both primaries and secondaries are silvered. These lustrous spots are disposed exactly as in other silvered members of the genus. Our plate does not bring out this effect to the degree that we would wish. It is extremely difficult in a four color plate to suggest the effect of silver, since it is not a true color.

Type. Our example is a ♀ and was taken by Mr. Jean Gunder in the Tejon region (Collins Ranch) on August 12, 1923.

COMANDRA NUDIFLORA n. sp.

DR. A. DAVIDSON

Stems leafy, 2-3 dm. high; leaves pale-green. ovate or ovate lanceolate, 2.5-3 cm. long, 12 mm. wide, sessile, paler beneath with manifest midrib; umbels 5-6 flowered, corymbosely clustered at the apex of the stem; flowers white, 5 mm. long; stamens without hairs at the base; fruit globular 6 mm. in width; fruiting pedicels 2 mm. long.

Type, 3604. Tehachapi Mts., Kern Co. Collected by Mrs. Wm. W. Hutchinson, May, 1925.

In vegetative characters it resembles *C. umbellata* but it has a more upright habit. The distinguishing feature is the absence of hairs on the stamens.

The Meteorology of Flight Conditions in Southern California

—— BY ——

FORD A. CARPENTER, Sc. D.,* LL. D.

There are four questions which nearly every member of the Academy would doubtless be interested in having discussed. Briefly stated, they would probably be the following: First, "Is there a basis of fact in the statement that flying weather in southern California is the best in the United States?" Second, "Why is local weather dependable for air-routes in and out of southern California?" Third, "What is the present status of military aeronautics in California?" and fourth, "What are some of the local problems confronting the advance of commercial aviation?"

Comparison of California with weather conditions in the United States—Climatic maps of the United States, as prepared by the United States Weather Bureau office in New York City are of more than passing interest. These maps indicate the regions where the various meteorological features reach their greatest intensity. The main features are the geographical distribution of severe local storms, the region of most persistent fogs, the states where the greatest extremes of temperature have been registered, the places recording the greatest snowfall and the largest number of thunderstorms.

The most severe local storm known to meteorologists is the tornado. It reaches its highest degree of intensity in the United States, the region of occurrence includes Minnesota in the north, Alabama in the east, Louisiana in the south and Oklahoma in the west. While this most spectacular and terrific meteorological phenomenon is of relative rarity and occurs in widely separated districts, the only retreat from its onslaughts is the "cyclone" cellar. Records show that it is very doubtful if buildings can be constructed tornado-proof and furthermore, predictions of the occurrence of tornadoes are not made by the Weather Bureau because of the relatively insignificant size of the whirlwind, and its extremely narrow path. Flight in tornadoes would, of course, be courting sudden death. Fortunately, tornadoes are a product of thunderstorms, and thunderstorm conditions are readily charted and air-courses should be arranged to avoid the quadrant of the atmospheric whirls where they invariably form. No matter how well-found aircraft may be, it is believed that no airplane, dirigible or balloon could survive if caught within the vicious whirl of such highly destructve storms. Tornadoes take tremendous toll in the aggregate as statistics prove. Two hundred lives and ten million dollars per annum is the annual tribute paid in the United States. In 1884, fifty-seven tornadoes in one day killed 1200 people, injured 3000, and wrecked about thirty-five million dollars of property. The reason tornadoes and similar windstorms are practically unknown in southern California is chiefly because the growth of these violent storms of spring and summer is prevented by the proximity of the cool Pacific ocean, and also by the absence of large level stretches of heat-

*Illustrated address, annual meeting of the Southern California Academy of Science, City Club, Los Angeles, May 4, 1925. Illustrations by the Author unless otherwise credited.

radiating land. Since the beginning of weather observations more than fifty years ago, there has never been loss of life in southern California directly attributed to weather.

Other interesting weather data are charted on the map referred to, such as: northern Montana having the coldest winters, the thermometer having dropped to 63 degrees below zero; southeastern Florida having the wettest summer climate with the maximum number of thunderstorms; the frequent fogs of the Atlantic coast, persistent winds on the Great Lakes. The interview with the New York Weather Bureau official in the "Popular Science Monthly" ends with this quotation: "One of our states, California,—can boast that it harbors almost side by side the hottest spot on earth (Death Valley) the pleasantest year-round climate (Southern California) and the heaviest snowfall (Central California) in the country."

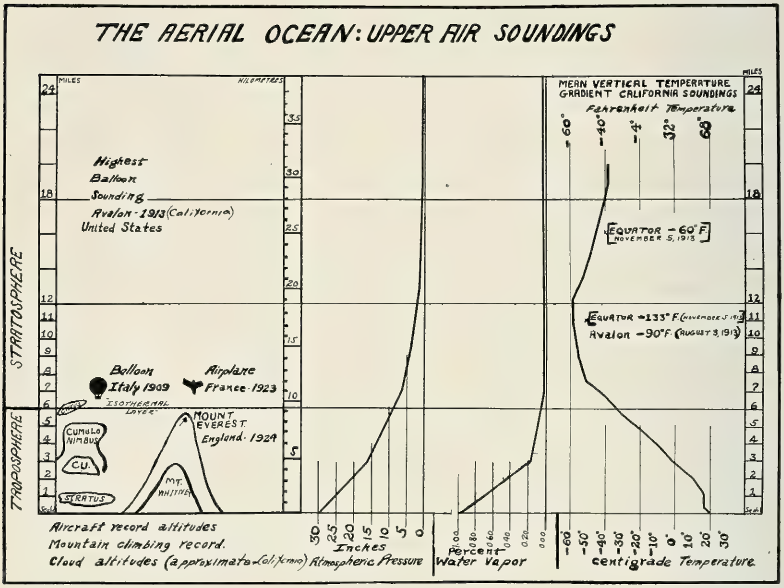

Fig. 6.

A CROSS SECTION OF THE ATMOSPHERE

This diagram represents the approximate depths of the "troposphere" (the six-mile layer next to the earth) and the "stratosphere" (six miles and higher above the earth) and the height to which aircraft have ascended and returned with records of barometric pressure, temperature, relative humidity, etc. These "soundings" depict (a) the gradual decrease in the height of the barometer with altitude, (b) the aridity of the upper levels of the atmosphere which limit the formation of clouds generally to the troposphere, and (c) the gradually increasing cold with ascent.

Southern California's place in aerial investigation—To the long list of record-making weather data might be added the results of the 1913 investigation of the upper air carried on in southern California (See Fig. 6) in which the writer, then in charge of the Los Angeles office of the United States Weather Bureau, was associated. The records then made have not been equalled anywhere in the world

although much of the data secured has been verified at various places on the globe. This particular work was carried on over the village of Avalon, Santa Catalina Island, which is about 30 miles south of Los Angeles (See Fig. 7). The accompanying diagramatic outline (Fig. 6) is a cross-section of the aerial ocean showing the various

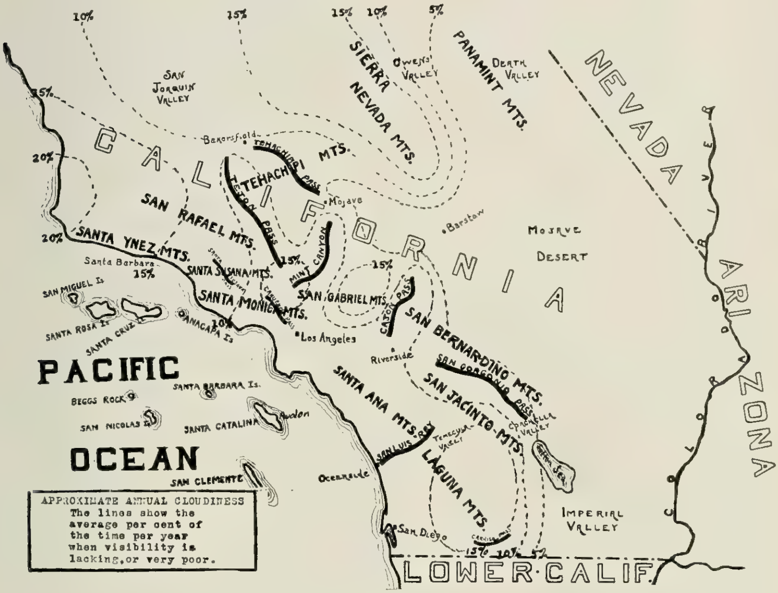

Fig. 7.

CHART SHOWING APPROXIMATE CLOUDINESS AND POSITION OF PRINCIPAL MOUNTAIN PASSES.

Visibility in air navigation is as important an element as in marine navigation. Air-pilots have to be as weather-wise as sea-pilots. This chart shows by dotted lines the percentage of the time when the sky is overcast by clouds, rain, etc. It also shows by short, heavy lines, the mountain passes through which airplanes and airships enter and leave Los Angeles and San Diego. Low grades are as important in laying out air-lines, as they are in planning railroads or highways. Gravity is no respecter of vehicles.

record altitudes of free sounding and manned balloons, and airplanes, with approximate heights of clouds in comparison with notable mountain peaks. Profiles are also shown of the well-known decrease of atmospheric pressure and humidity with altitude. It also shows in a somewhat striking manner the relatively shallow covering of air which surrounds the earth and the great rapidity with which the air becomes colder with elevation above the earth's surface. It is interesting to note that within a few months of the time that the temperature of 90 degrees below zero (August 3, 1913) was obtained at an elevation of 11 miles above Santa Catalina Island, a temperature of 133 degrees below zero was obtained (Nov. 5, 1913) by a colleague of the writer's at the same altitude above Batavia at the equator. A direct benefit to aerial transportation was secured from these studies in that it proved that extraordinarily high wind velocities at considerable altitudes do not exist at least in this portion of the country,

and that the wind velocity increased as the barometric pressure decreased. To this steady increase in wind velocity might be added the inconsequential circumferential velocity of the earth on its axis, which, at the equator would be about one mile per hour to every four miles in altitude. Out of 23 meteorographs sent up during 1913 over Avalon in free sounding balloons, 18 were recovered and the drift of the balloons showed that the movement of the upper air was not more than the usual rate of increase in wind velocity with altitude. These and subsequent aerial investigations in southern California, of which there have been many during the ensuing dozen years, point conclusively to the fact that the lower air levels in this vicinity are seldom disturbed by gusty or heavy winds, that the normal winds are from different directions at varying altitudes (often being of a reverse direction), that eastward flights are profitably made at relatively high levels, and that westward journeys should be taken near the earth's surface. To these deductions should be added the information that the air of southern California is but infrequently disturbed by the great aerial eddies known as "highs" and "lows" that cross the United States at higher altitudes with the regularity of "beads on a string" as one meteorologist happily pictures the drifing succession of these barometric pressure areas. Success in predicting weather at present, depends entirely on the ability of the forecaster to foretell the rate of movement and development of these whirling aerial eddies. These "lows" of the weather map often move eastward with the regularity and speed of transcontinental railroad trains. They often have delays, run out of fuel (which in the case of the "lows" is moisture), but, nevertheless often their course may be plotted to a nicety as witness the international eliminating balloon race which took place in April of this year. On the day before the race the writer sent a meteorological synopsis for the benefit of the contesting balloon pilots, complying with requests made several months previous when lecturing at Akron. This telegram outlined the weather controls and their effect and advised the course that won the race making 600 miles in 30 hours. A balloon journey of 20 miles per hour for 30 hours would be an impossibility over the Pacific states, and record balloon flights for speed and distance will always be impossible in southern California. There are windstorms in southern California, but they are too infrequent to be of any assistance in record-breaking air journeys. The "Santa Ana" wind occurs twice or three times a year; this is a brisk, drying wind. The normal winds are of two varieties: the land-and-sea and mountain-and-valley. These are of daily occurrence, being atmospherically tidal in their character and effect, and are caused by the unequal heating of the air over mountain, valley and ocean.

Dependability of weather for air-routings—There is one weather feature which gives the airmen greatest concern, as it does, in fact, the seaman, that is, visibility. Fog and cloud often present spectacles of esthetic beauty (See Fig. 8) but they are the great enemies of pilots whether of air or sea. Fog is still the greatest danger to the seaman although the seas have been sailed for thousands of years. Aside from thunderstorms and kindred phenomena, fog, clouds and mist, rain or snow are the chief bugbears of the air pilot. For several years there have been carefully charted from data secured from the Weather Bureau and the Mount Wilson astronomical observatory the length of time fog, cloud or rain impeded vision, and the thickness of this cover or "ceiling" as air pilots term any cloud-cover. The results for a normal year (See Fig. 9) show that during this period there were three days when the sky was covered from sunrise to sunset and that on two of these days the column of cloud was more

Fig. 8.

CHARACTERISTIC CLOUDS OF SOUTHERN CALIFORNIA

Photographed by Ferdinand Ellerman

This photograph made from Mount Wilson, shows the prevailing cloud types of southern California. The higher clouds, the **cirrus** and **alto-stratus** will be noted in the upper portion of the picture, while the tops of the **cumulus** clouds are just showing above the horizon. The **stratus** cloud is festooning the pine-clad shoulders of the mountain in the foreground. These billows of **stratus** cloud are the upper surfaces of the familiar **velo** (Spanish **el vello**) veil-cloud, which is the early morning and late evening cloud of southern California.

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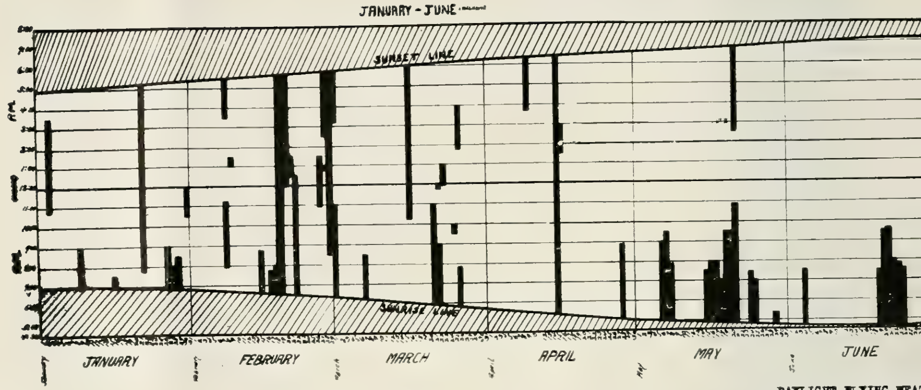
than 6000 feet thick. In other words, the aviator would have to ascend higher than a mile in altitude to fly above such a "ceiling." This, however, occurred on but two of the 365 days. A further study of this chart shows that while nearly all of the sunsets are clear, one-quarter of the sunsets are cloudy. The "high fog," or velo cloud (See Fig. 8) has a duration of about two or three hours of daylight on the 60 days in the year that it occurs, this cloud lifting and disappearing about 8:30 a. m. During the life of the velo cloud its thickness averages about a thousand feet. The practical significance of the data proffered by Figure 9 is that any schedule of air flights should be arranged for their departure after 8 in the morning if they plan to maintain time-table regularity. Going and returning flights may be profitably ordered at different levels. The extensive studies of the Weather Bureau, the Air Service, and the research work of the department of meteorology and aeronautics of the Los Angeles Chamber of Commerce show that the drift of the atmosphere is dependable at different air levels. Studies of cloud movement show the varying directions and velocity of the upper air. Often it will be observed that

WEATHER AND FLYING IN



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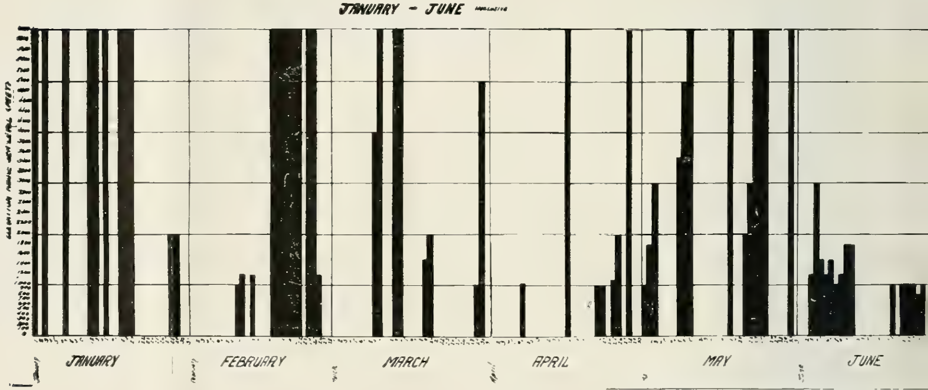

DAILY HEIGHT OF CLOUD-COVER OVER SAN

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AVERAGE VISIBILITY

The upper diagram shows by heavy vertica out an average year. The lower shaded portion sunset hour. For example, during the period o less or covered only on portions of the day. It sunrises are clear during 297 days, the sunsets w

The lower diagram depicts the height of th the cloud observations. The horizontal lines re thickness in intervals of one thousand feet. It cloud-heights average less than fifteen hundred value to the air pilot as he can fly above these quent cloudiness of 6,000 feet in thickness that a

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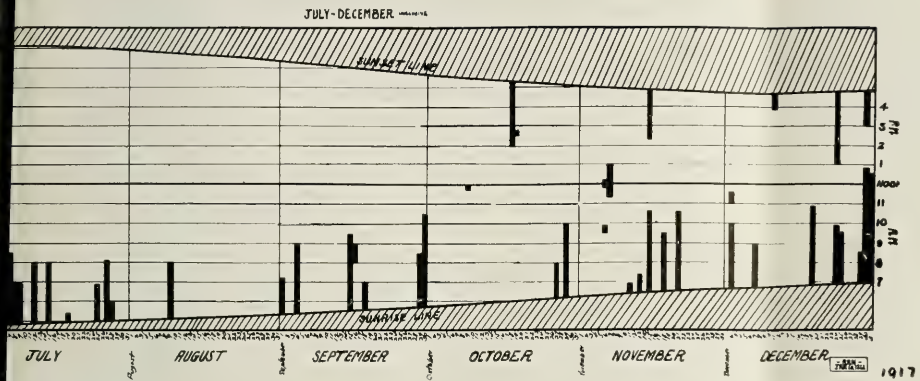

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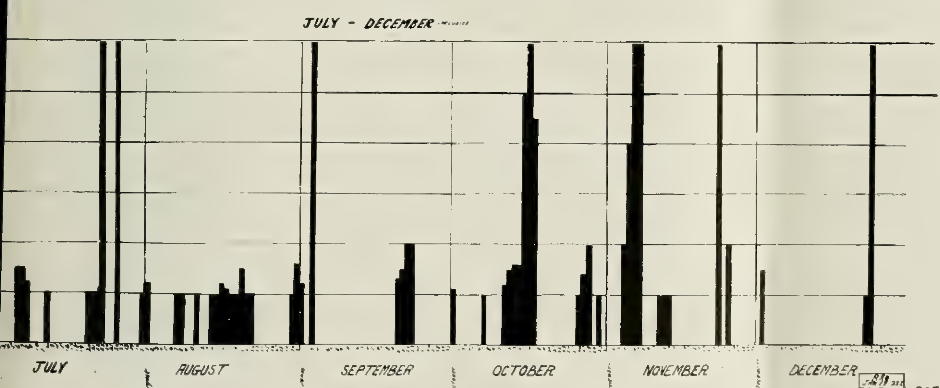

L VALLEY, NEAR LOS ANGELES, CALIFORNIA

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9.

SOUTHERN CALIFORNIA

s the hours of cloudy weather day by day through-
he sunrise line and the upper shaded portion is the
days there were 363 days when the sky was cloud-
be observed in perusing this chart that while the
lear on 349 days.

d up to six thousand feet which was the limit of
t a cross-section of the air over a mile in vertical
e observed that the late spring, summer and autumn
n thickness. This information is of great practical
lo" clouds. It is only during the relatively infre-
vel would be delayed.

these upper air currents are directly opposite to each other in neighboring levels. This is of great advantage in planning air flights, for the wind is as much help or hindrance to fast-flying airplanes as it is to the slower moving dirigibles, or wind-dependent balloons. There are fewer "holes-on-the-air," "aerial cataracts" or "air-fountains" than in other regions of the United States because of the absence of strong ascending or descending winds. Whenever air flows down the side of a mountain range air pilots will, upon flying in the direction of this current, experience the feeling of encountering an "air-pocket," or a "hole in the air." This is because all aircraft, whether airplane or dirigible, thus loses suspension; the "lift" being dynamically taken out of the craft. The same is true in encountering a column of descending air, as in a thunderstorm front. The only unfavorable winds normally encountered in southern California are the "Santa Ana" winds which are similar to the "norther," only unlike them they occur on an average of less than three annually. These storms are invariably heralded a day or two in advance by Weather Bureau warnings.

Aeronautic activity in national defense training—For a decade both the Army and Navy have maintained large and flourishing air-training schools in southern California, and fatalities from adverse weather conditions are practically unknown. Primary training in both branches of the service has been generally centered here: advance training is carried on in the Texas, Illinois, and Ohio air-fields. The center of army and naval aerial work is on North Island, San Diego Bay (Fig. 10) one of the most climatically perfect locations in the world. Although the island was originally purchased for the aeronautic work of the War Department, the Navy Department has gradually taken to itself more and more of the territory until at present writing the naval air service's aeronautic research work there is unequalled by any western military establishment. All manner of intricate flight maneuvers such as Fig. 12 depicts are a matter of daily occurrence over North Island by both the army and navy airplanes. Southern California is fortunate in having notable airplane designers and excellent factories for turning out ships of high class. The navy's great torpedo plane was designed and made by one of these factories which concern also made the celebrated world air cruisers. There is no better testing laboratory for air transportation equipment than this region, for no other locality is so justly famous for climatic excellencies. Investigation and research is carried on in southern California day after day without interruption by changing weather conditions. It has been stated by officers of the military establishments that many times the number of air pilots were graduated at Ross Field, near Los Angeles, during its active existence than would have been possible in any other section of the United States. The necessity of dependable and efficient aircraft for national defense has been too clearly demonstrated to need any comment; it is only pertinent to quote from an unprejudiced military authority who recently said: "Whichever side loses control of the air will be as a man with his eyes put out. Without airplanes it is impossble to know the movements of the enemy or to fire long range guns with accuracy." This explains the feverish and intensive work in aeronautics which has characterized the navies of the world during the past year. One has but to mention the equipping of all battleships with airplanes for their defense, submarines with airplanes for "eyes," and more important than all, airplane carriers. The writer was the War Department's meteorologist during the historic bombing of the ex-German battleships off the Virginia capes in the summer of 1921 and took part in this greatest of all peace-time maneuvers. It was the ready destruction of these up-to-date battleships, cruisers,

Fig. 10.

THE ARMY AND NAVY AVIATION FIELD OF NORTH ISLAND, SAN DIEGO

For the past ten years the United States government has used North Island in San Diego bay as a flying field. It has no equal in the world for this purpose and has been in continuous use by both branches of the military service as well as commercial aviation. The photograph shows characteristic Point Loma with the Pacific ocean in the distance, the entrance to San Diego bay in the upper background and a nearer view of the bay in the foreground. The buildings in the lower half of the photograph are of the aviation establishment of the Navy, and in the buildings in the middle left are those of the air service of the Army.

Fig. 11.

TYPES OF PLANES USED BY THE U. S. ARMY AND NAVY

Photographs by the U. S. Army and Navy Air Service

The upper photograph represents the flagship of the Round-the-World air-cruisers at Clover Field, Santa Monica, California, from which station the flight started March 17, and finished September 26, 1924. The airplanes of the first aerial circumnavigation of the globe were designed and built by Donald Douglass of Santa Monica.

The lower photograph shows the standard naval seaplane, one of the F-5-L type, having two 400 h. p. Liberty motors, which is twice the horsepower of the airplane in the upper part of this page. This particular type of plane has been in use in carrying mail and passengers for the navy department between the harbors of Los Angeles and San Diego for many years.

destroyers and submarines in the vicinity of the other history-making encounter of the "Monitor" and "Merrimac" that doubtless caused the general acquiescence of the powers in limiting the number of battleships. By a strange subtlety known only to diplomats, battleships at that date only partially completed were later converted into airplane carriers. The United States has one such converted battleship which carries seventy-two airplanes and has an electric power plant equal in watt-hours to the running of every light, furnishing power to every factory, and street railway in a city of a million people.

What hinders advancement in commercial aviation?—Mr. Will Hayes recently stated: "When we cease exploiting the military side of aeronautics, and boost its business value, when we stop talking about the killing power of the airplane in warfare and show how it can be used to shorten time and thus prolong life, then and then only will aeronautics take its rightful place in the commercial world." Public attention and practical support can be secured by demonstrating the safety and dependability of flight as a means of rapid transportation. The last few years has fortunately seen a rapid decline of public interest in stunts and stunt flying. The newspapers have done splendid service in giving space to civil aeronautics; perhaps in some instances they have seemed to over stimulate the readers' credulity. Be that as it may, it is time for business men to see the advantage of using the newest and speediest means of transportation of passengers and express. There is no doubt about the flying qualities of the models used by American airmen, or the airmanship of the American aviator, whether military or civilian, as the marvelous performance of the Air Service and the Air Mail have shown. Nowhere in all the world has so long or so difficult an air route been so successfully maintained as that between New York and San Francisco: it is the admiration of all nations. How can the public aid in making air transportation commercially successful? This question has been uppermost in the mind of the writer for nearly a score of years. He has been engaged in flying for more than half that time, having had the "controls" of all kinds of government-operated aircraft during the past decade and his several hundred hours in the air have been free from all delays or inconveniences. So much for personal observations and experiences. It is a well-strengthened opinion that the public can give practical support to commercial aeronautics in five ways: First, by considering air travel as a legitimate means of transportation and not as an adventure, or for the thrills it may cause. Second, by using properly accredited aerial transportation companies when desiring quick carriage of themselves or valuable freight. Third, by continually supporting all public measures which have for their object the legitimate use of aircraft in business. Fourth, by encouraging the setting aside of the public domain such as parks, etc., for landing fields. Fifth, by recognizing the air mail as a well-demonstrated means of rapid communication and forming the habit of using it in correspondence. Nature has done everything to make artificial flight in southern Californa safe and efficient. Local weather is almost invariably an aid and not a menace and experiments and demonstrations in aeronautics may usually rely upon the constancy of ideal meteorological conditions.

Fig. 12

THE HIGHWAY OF THE AIR

Photograph by the U. S. Navy

The photograph at the top of this page shows fast-flying **alto-cumulus** clouds at an elevation of 14,000 feet. The lower photograph is of a squadron of naval airplanes flying in formation through **velo** clouds over San Diego bay.

THE SHRUBBY MALVASTRUMS OF SOUTHERN CALIFORNIA

— By —

FREDERICK EARL ESTES

INTRODUCTION

The shrubby Malvastrums of Southern California have been a group of considerable difficulty to local botanists on account of their perplexing variability, the lack of adequate keys and descriptions, and the complex synonomy. Under the direction of Dr. Philip A. Munz of Pomona College, I began in 1923 a study of the group. In the winter of 1924-25, Dr. Munz, while working at the Gray Herbarium, studied material and secured photographs of types. The present paper represents the results of this work as well as of some field study.

In citing specimens in the different herbaria, the following abbreviations indicated in parentheses are used: Pomona College Herbarium (Po), Herbarium of F. W. Peirson of Pasadena (FP), and University of California (UC). Our expression of thanks is due to Mr. F. W. Peirson for the use of his excellent material, also to Dr. W. A. Setchell of the University of California for the use of the abundant material there, and to Dr. I. M. Johnston of the Gray Herbarium for looking up material at Harvard.

KEY TO THE SPECIES

Calyx scurfy with very short stellate hairs; ultimate flowering branchlets slender, 1-2 mm. thick.

Leaves very firm in texture, almost leathery, often revolute; island of Santa Cruz..............................1. *M. nesioticum.*

Leaves not revolute nor leathery; mainland species.

Calyx segments generally 2-3 mm. long; leaves scarcely if at all bicolored, upper as well as lower surface with hoary stellate tomentum; leaf-lobes mostly very obtuse; Santa Barbara and Ventura Counties......................2. *M. Nuttallii.*

Calyx segments usually 4-5 mm. long; leaf-lobes pointed, upper surface always greener and more sparsely pubescent.

Inflorescence a spicate raceme, scarcely branched; southern Riverside and San Diego Counties....3a. *M. fasciculatum.*

Inflorescence branching and paniculate; Los Angeles to Riverside and San Bernardino Counties..3b. *M. fasciculatum* var. *laxiflorum.*

Calyx rather long-pubescent or hirsute; ultimate flowering branches often thicker and more rigid, 2-2.5 mm. thick.

Bractlets about as long as the calyx, or if shorter, calyx having hispid pubescence.

Lower leaf surface white-silky canescent with dense stellate tomentum, upper surface green; San Clemente Island...4. *M. clementinum.*

Leaf surfaces much more nearly alike; mainland species.

Calyx pilose with long stellate tomentum; inflorescence somewhat glandular; leaves mostly 3-5 lobed or angled.

Calyx segments 7-12 mm. long; bractlets 7-16 mm. long; northern San Diego County and Riverside and Orange Counties.....................................5. *M. densiflorum.*

Calyx segments 3-7 mm. long; bractlets 4-6 mm. long; southern San Diego County and northern Lower California..... ....5b. *M. densiflorum* var. *viscidum.*

Calyx with very thick stellate tomentum; inflorescence only slightly if at all glandular; leaves more nearly round and less angled and lobed; western end of the Mohave desert ....6. *M. gabrielense.*

Bractlets markedly shorter than the calyx; calyx with soft pubescence.

Calyx not obscured by its thick close stellate tomentum; segments hardly equalling the tube; leaves rather thickish and generally large, with main veins on under surface very thick; San Fernando Valley ....7. *M. Davidsonii.*

Calyx obscured by somewhat stellate tomentum; segments equalling or slightly exceeding the tube; leaf-veins not conspicuously thick; Kern and Ventura Counties along western edge of the Mojave desert to San Bernardino County............. .... 8. *M. orbiculatum.*

TREATMENT OF SPECIES

1. **Malvastrum nesioticum** Robinson. Synop. Fl., 1, pt. 1:312. 1897.

M. nesioticum Robins, in Davidson & Moxley, Fl. So. Calif., 233. 1923. *Malacothamnus nesioticus* (Robins.) Abrams, Bull. N. Y. Bot. Gard. 6:419. 1910. *Malvastrum Thurberi* of Brandegee, Zoe 1:133. 1890 for Santa Cruz Island. *Malvastrum Thurberi* var. *laxiflorum* of Greene, Bull. Calif. Acad. Sci. 2:392. 1887.

A much branched shrub; branches and stems canescent with a minute stellate, somewhat rusty tomentum; ultimate branches slender, 2-3 mm. thick; leaves of very firm texture, somewhat pentagonal, shallowly 3-5 lobed, when well developed deeply and narrowly cordate, tip more or less obtuse, margin crenate or subentire and often revolute, blade 2-4 cm. long and 1.5-4 cm. broad, green above and appearing smooth, yet minutely stellate-pubescent, almost white beneath with dense short stellate pubescence; flowers in a rather rigid ascending panicle, peduncles 2-3 cm. long, vesture as in stem; pedicels 1-2 cm. long; calyx campanulate, 5-8 mm. long, segments 2-3 mm. long, and 3-5 mm. broad at base, obtusish, and covered with a minute stellate canescent tomentum; bractlets only 1-2 mm. long, lanceolate to lance-ovate; corolla probably pink, becoming rose-purple with age; petals asymmetrically obovate and slightly clawed, 13-16 mm. long, and 12-14 mm. broad; carpels 1.5-2 mm. high; seeds triangular, 0.8 mm. long, brown.

Known only from the Island of Santa Cruz, from which the following material has been seen: *Brandegee in* 1888 (UC); photograph of type at the Gray Herbarium, *E. L. Greene in* 1885 (Po).

This species seems to be intermediate between *M. Nuttallii* and *M. fasciculatum* var. *laxiflorum*, having the leaf outline of the former, but with the upper surface green and nearly glabrous. Dr. Gray considered this plant as perhaps only an extreme form of the variable *M. fasciculatum*, but no mainland species yet seen has such a decidedly different foliage and such a rigid long-pediceled panicle.

2. **Malvastrum Nuttallii** (Abrams) Davidson & Moxley, Fl. So. Calif., 233. 1923.

Malacothamnus Nuttallii Abrams, Bull. N. Y. Bot. Gard. 6:417. 1910.

Shrub 2-3 m. high; branches erect or ascending, canescent with dense short-rayed pubescence, ultimate branches 2-3 mm. thick; leaves

more or less acutely 5-lobed, often cordate when well developed, tips mostly obtuse, margin crenate-serrate, blade 2-3.5 cm. long, 1.5-3.5 cm. broad, equally hoary on both surfaces with a close, soft, short-rayed stellate pubescence; petioles 1-2 cm. long; flowers in a loose compound inflorescence; pedicels 1-2 cm. long; vesture as in branches; calyx 6-8 mm. long, segments 2-3 mm. long, and 2-3 mm. broad at base, distinctly pointed at tip, and covered with a minute stellate canescent pubescence; bractlets only 1-2 mm. long, lanceolate; corolla probably pink, or rose-purple with age; petals 1-2 cm. long, 8-12 mm. broad; carpels stellate pubescent on the summit, obovate, 3 mm. high.

Apparently confined to the Upper Sonoran Zone of Santa Barbara and Ventura Counties. Santa Barbara Co.; Gaviota Pass, *Abrams* 5030 (Po); Santa Ynez Mts., *Elmer* 3730 (Po). Ventura Co., Casitas Pass, photograph of specimen in the Gray Herbarium, *Abrams in* 1908 (Po).

The inflorescence of this species resembles most closely that of *M. fasciculatum* var. *laxiflorum*, but is distinguished by having both leaf surfaces equally hoary and by the obtuse lobes.

3. **Malvastrum fasciculatum** (Nutt.) Greene, Fl. Fran. 108. 1891.

Tall shrub, usually 1-5 m. high, often large and arborescent, with the woody base often 2 cm. or more thick; branches long, wand-like, slender, racemose or amply racemose-paniculate above; bark smooth, gray; stem canescently short-tomentose, almost scurfy; ultimate branches 1-2 mm. thick, vesture as in stem; leaves shallowly or acutely 3-5 lobed, mostly subcordate, crenate; tip either pointed or rounded; blade varying from 2-8 cm. long, almost as broad, lower surface rather densely canescent with short stellate hairs; upper surface somewhat darker and less densely canescent; petioles 0.5-2 cm. long; flowers in spicate clusters or paniculately disposed on virgate, nearly naked branches; peduncles sometimes 1 cm. long; calyx 6-8 mm. long; segments 4-5 mm. long and 2-3 mm. broad at base, more or less obtuse and with or without a short point; bractlets 2-4 mm. long, lanceolate; corolla pink, petals 10-15 mm. long, 8-10 mm. wide and slightly clawed; carpels obovate-oval, 2-3 mm. high; seeds roughly triangular, appearing minutely glandular.

3a. **Malvastrum fasciculatum** var. **typicum** n. var.

Malva fasciculata Nutt. in T. & G. Fl. of N. Am. 1:225. 1838. *Malvastrum fasciculatum* of Greene, Fl. Fran., 108, 1891, for material from Southern Riverside and San Diego Counties; probably of Millspaugh & Nuttall, Field Mus. Pub. Bot. 5:173. 1923. *Malvastrum Thurberi* of Lyon, Bot. Gaz. 11:333. 1886, of Trask, Erythea 7:143. 1899, of Brandegee, Zoe 1:133. 1890, of Brewer & Wats., Bot. Calif., 1:85. 1876, of Robinson in Gray, Synop. Fl. 1 pt. 1:312. 1897, and of Davidson & Moxley, Fl. So. Calif., 233. 1923, the last three references for plants of San Diego and Riverside Counties.

Inflorescence a spicate raceme, scarcely branched.

Locally fairly abundant on dry slopes and in dry washes of the Upper Sonoran Zone. Occurring mostly at low altitudes in the coastal drainage of San Diego County and Riverside County. Occasionally reaching the edge of the desert, e. g., *Hall* 765 from Santa Rosa Mts. Riverside Co.: Winchester, *Hall* 528 (UC); El Toro Peak in Santa Rosa Range, *Hall* 765 (UC). San Diego Co.: Between Fallbrook and San Luis Rey, *Abrams* 3348 (UC); near Bonsall, *Munz & Harwood* 3876 (Po, UC); Miramar to La Jolla, *T. S. Brandegee in* 1903 (UC); coast near La Jolla, *Peirson* 775 (FP); La Jolla, *Clements in* 1914 (UC); San Diego, *K. Brandegee in* 1906 (UC); San Diego, *T. S. Bran-*

degee 1626 (Po, UC); San Diego, *L. Kendall in* 1920 (Po); near San Diego, *Hall* 3960 (UC); Point Loma, *Mrs. Spencer* 100 (Po, UC); Balboa Park, San Diego, *L. Street in* 1917 (Po); photograph of type material at the Gray Herbarium, *Nuttall* (Po).

Nuttall's collection at the Gray Herbarium is labeled as coming from Santa Barbara, but the label is no doubt in error, since all typical material is much more southern, and his specimen must have come from San Diego, where he is known to have collected.

There is much material intermediate between this species and its variety *laxiflorum* coming largely from a region lying between southern Riverside County and Los Angeles County. Many specimens can scarcely be referred either to the species or the variety: Los Angeles Co.: Topango Canyon road, *M. Hitchcock* 25 (Po); Griffith Park, *E. Braunton* 541 (UC) and 220 (UC); Azusa, *Abrams in* 1902 (Po); San Antonio Wash, *Peirson* 109 (FP); San Gabriel Wash, *Johnston* 982 (Po). San Bernardino Co.: Southern slope San Bernardino Mts., *Parish* 7136 (UC). Riverside Co.: Wilder's Canyon, Jurupa Hills, *Mrs. Wilder* 35 (Po); Palm Springs, *G. B. Grant in* 1906 (UC); Elsinore, *Mrs. J. D. Abrams in* 1901 (Po).

3b. **Malvastrum fasciculatum var. laxiflorum** (Gray) Munz & Johnston, Bull. Torrey Bot. Club 51:296. 1924.

Malvastrum Thurberi var. *laxiflorum* Gray, Proc. Am. Acad. 22: 291. 1887, Robinson in Gray, Synop. Fl. I, pt. 1:312, 1897. *Malvastrum laxiflorum* of Davidson & Moxley, Fl. So. Calif., 233. 1923. *Malvastrum fasciculatum* of Davidson, List Pls. L. A. Co., 3. 1892. Erythea 4:68. 1896, Cat. Pls. L. A. Co., 5. 1896, and of Reed, Muhlenbergia 5:96. 1909, and of Abrams, Fl. L. A., 249. 1904 and 229. 1917. *Malvastrum splendidum* Kell., Proc, Calif. Acad. 1:65. 1855. Brewer & Wats., Bot. Calif. 1:85. 1876. *Malacothamnus fasciculatus splendidus* (Kell.) Abrams, Bull. N. Y. Bot. Gard. 6:417. 1910. *Malveopsis fasciculata* (Nutt.) O. Ktze., Rev. Gen. 1:72. 1891. Greene, Man. Bot. S. F. Bay, 66. 1894 for plants of northern Riverside County to Los Angeles County. *Malveopsis splendida* (Kell.) Ktze., Rev. Gen. 1:72. 1891.

Inflorescence branching and paniculate.

Occurring in situations similar to the var. *typicum*, but of more northern distribution, occurring from northern Riverside County and Orange County to San Bernardino and Los Angeles Counties. Los Angeles Co.: Santa Monica, *State Survey* 81 (UC); Los Angeles, *Davidson in* 1892 (UC); Big Dalton, *Peirson* 114 (Po); Azusa, *Abrams* 1558 (Po); Claremont, *Illingsworth in* 1898 (Po), *Baker* 3346 (Po), *Walker in* 1898 (Po). Orange County: Laguna, *Peirson* 4662 (FP); Laguna, *Munz* 5748 (Po); Aliso Creek, *Peirson* 3398 (FP); Aliso Canyon, *Johnston in* 1924 (Po). Riverside County: Riverside, *Jaeger* 1163 (Po.); Perris, *Johnston in* 1918 (Po.); Lakeview, *Johnston in* 1920 (Po); Temescal Canyon, *Johnston* 2024 (Po); San Jacinto, *Spencer* 2187 (Po). San Bernardino Co.: Colton, *Johnston* 2279 (Po); Lone Pine Canyon, *Pierce in* 1923 (Po); San Bernardino, *Parish* 3804 (UC).

4. **Malvastrum clementinum** Munz & Johnston in Bull. Torrey Bot. Club, 51:296. 1924.

A rounded tufted shrub with many ascendingly branched stems 7-10 dm. high; stems rather coarse, tomentose when young; leaves angularly 3-lobed or orbicular or ovate, 3-5 cm. broad, base cordate, margin irregularly crenate, upper surface green but with a very sparse stellate tomentum, veiny; flowers many, subsessile and densely glomerate in the axils of the uppermost leaves and continuing out into an

elongate naked interrupted spike 1-2 dm. long; calyx 7mm. high, loosely stellate-tomentose; calyx-lobes broadly lanceolate, acute, enervose, 4 mm. long; bractlets filiform, well developed, nearly reaching the tips of the calyx-lobes; corolla pink, in color suggesting that of apple-blossoms; lobes oblong-obovate, about 13 mm. long; carpels 2.5-3 mm. high, 8-10, thin-walled, smooth, promptly deciduous, inner edge excised, summit stellate-tomentose, sides and base glabrous; seeds ovoid, 1.8 mm. long, short villous.

Known only from San Clemente Island, where it grows at the base of rocky walls in a deep canyon on the northeast side of the island. San Clemente Island, *Munz* 6684 (Po); San Clemente Island, *Peirson* 3458 (FP).

5. **Malvastrum densiflorum** Watson, Proc. Am. Acad., 17:368. 1882.

Erect, 1-2 m. high, suffrutescent below; branches scurfy with very short stellate tomentum, ultimate branches 2-4 mm. thick, and scurfy; leaves roundish to distinctly 3-lobed, base seldom cordate, roundish leaves irregularly dentate-crenate, lobed ones more nearly serrate; blade 2-4 cm. long, 1.5-3.5 cm. broad, upper surface very sparsely short-stellate, varying to somewhat more dense, lower surface much the same; petioles 0.5-2 cm. long; flowers numerous in sessile heads along the naked summit of the branches, distant or approximate in an interrupted spike; calyx 6-17 mm. long, hispidly hirsute with slender spreading hairs or seldom with a very thick tomentum of stellate hairs, segments 4-12 mm. long, 2.5-3 mm. broad at base, lanceovate and attenuate-accuminate; bractlets 7-17 mm. long; corolla rose-pink, petals 10-15 mm. long, slightly clawed; carpels 2 mm. high, seeds triangular, 1.5 mm. long, sparingly glandular-pubescent.

5a. **Malvastrum densiflorum** var. **typicum** n. var.

Malvastrum densiflorum Watson, Proc. Am. Acad. 17:368. 1882. Robinson in Gray, Synop. Fl. 1, pt. 1:310. 1897. Davidson & Moxley, Fl. So. Calif., 233. 1923. *Malvastrum fasciculatum* "form" of Davidson, Erythea 4:68. 1896.

Calyx segments 7-12 mm. long; bractlets 7-16 mm. long.

Dry slopes in the chaparral from the vicinity of Palm Springs, Riverside County, west to Orange County, and south to northern San Diego County. Riverside County: Santa Ana Mts., *Munz* 7099 (Po, FP); photograph of type at the Gray Herbarium, Colorado Desert, *Wright* 200 (Po); Temecula River, *Peirson* 2189 (Po, FP). San Diego County: Cuyamaca Mts., *Hall in* 1899 (UC); Witch Creek, *R. D. Alderson* 418 (UC).

The more southern specimens generally have shorter and broader calyx segments than does the type, which comes from the vicinity of Palm Springs, and thereby approach the variety *viscidum*. A collection at Menifee, Riverside County, *Miss King in* 1893 (UC), and one at San Juan Capistrano, *J. C. Nevin* (UC) are quite intermediate. The Nevin collection is cited by both Watson and Abrams in their descriptions. The characters given by Abrams for *viscidum*, i.e. glandular condition, etc., do not hold.

5b. **Malvastrum densiflorum** var. **viscidum** (Abrams) nov. comb.

Malvastrum viscidum Abrams, Bull. Torrey Bot. Club 34:264. 1907. Davidson & Moxley, Fl. So. Calif., 233. 1923.

Calyx segments 3-7 mm. long; bractlets 4-6 mm. long.

Southern San Diego County and northern Lower California. Habit and habitat similar to that of variety *typicum*. San Diego Co.: photograph of part of the type collection at Gray Herbarium, Harvey's Ranch, near El Nido, *Abrams* 3528 (Po); Ramona, *T. S. Brandegee in* 1894 (UC); Ramona, *K. Brandegee in* 1903 (UC); San Diego County (without locality), *R. D. Alderson in* 1893 (UC); Dulzura Grade, *Munz* 9470 (Po). Lower Calif.: 17 miles southeast of Tecate, *Munz* 9506 (Po).

This plant becomes a slender open shrub, 6-8 ft. high, but when burned over, throws up a second growth which blooms when still quite herbaceous.

6. **Malvastrum gabrielense** Munz & Johnston, Bull. Torrey Bot. Club 52:223. 1925.

Erectly branched shrub ca. 2 m. high; branches rather slender, virgate, with a dense close stellate pubescence; leaves scattered, firm, shorter than the internodes, 2-4 cm. long, 1.5-2.5 cm. broad, obscurely 5-lobed, coarsely and irregularly serrate-dentate, stellate-pubescent, pale green, beneath somewhat lighter and prominently veined, apex broadly acute, base somewhat cordate; petiole densely stellate, 5-15 mm. long; stipules subulate, 8-9 mm. long, early deciduous; flowers in few-flowered glomerules in the upper axils; pedicels 0-3 mm. long; bractlets subulate, 7-12 mm. long, shorter or longer than the calyx; calyx 10-12 mm. high, loosely stellate pubescent, simply tomentose inside; calyx-lobes lance-ovate, ca. 8 mm. long, 3 mm. broad, strongly acuminate, enervous; petals pink, 16-18 mm. long, 8-9 mm. wide, strongly oblique-asymmetrical, sessile, rounded above; styles ca. 8 mm. long; style-lobes glabrous, slightly thickened at the summit, 2-3 mm. long, ca. 10; stamens ca. 50, glabrous except at the very base; connective prolonged as a subulate appendage which about equals the length of the anther-sacs; ovary stellate pubescent; mature fruit unknown.

Occurring about the western end of the Mojave Desert from Mt. Pinos to the San Gabriel Mts. Ventura County: Seymour Creek, Mt. Pinos region, *Peirson* 3248 (FP). Los Angeles County: Ravenna, *K. Brandegee* (UC); type, Arraster, *Peirson* 774 (Po, FP).

7. **Malvastrum Davidsonii** Robinson, in Gray, Synop. Fl. 1, pt., 1: 312. 1897.

Malvastrum Davidsonii of Abrams, Fl. L. A., 249. 1904 and 229. 1923. Davidson & Moxley, Fl. So. Calif., 233. 1923. *Malvastrum splendidum* of Davidson, Erythea 4:68. 1896; Cat. Pls. L. A. Co., 5. 1896. *Malacothamnus Davidsonii* (Robinson) Greene, Leaflets 1:208. 1906. Abrams, Bull. N. Y. Bot. Gard. 6:418. 1910.

Tall arborescent shrub 2-5 m. high, with relatively few coarse branches, ultimate branchlets 2-7 mm. thick, very scurfy with thick stellate tomentum; leaves thickish, somewhat rugose, with very heavy veins below, generally rather large; blades 2.5-5 cm. long, almost as broad, all cordate, tip often very obtuse, sometimes pointed, 5-angled or shallowly 5-lobed, varying to 3-lobed, irregularly dentate, both surfaces covered with a copious loose stellate tomentum; petioles 0.5-1.5 cm. long; flowers numerous, clustered in, or shortly racemose from the upper axils and also forming dense rather stiff sub-spicate terminal inflorescences; peduncles 1-4 cm. long, pedicels 0.5-1 cm. long, both having same vesture as the branches; calyx 5-8 mm. long, segments 2-4 mm. long, 2-3 mm. wide at base, canescent-tomentose, and with or without more naked mucronate tips; corolla pink or rose; petals asymmetrical, 6-12 mm. long; carpels 2 mm. high, 10-11; seeds 1.5 mm. long, triangular, brown or black.

Apparently a shrub of dry sandy and stony washes in the San Fernando Valley and vicinity. Los Angeles County: photograph of type at the Gray Herbarium, San Fernando, *Davidson in* 1895 (Po); Pacoima Wash near San Fernando, *F. Grinnell Jr. in* 1917 (Po); Pacoima Wash, 2 mi. southeast of San Fernando, *Munz* 9405 (Po). A specimen from Ojai, Ventura County, *Peckham in* 1866 (UC), is not typical and only fragmentary, but probably belongs here.

8. **Malvastrum orbiculatum** Greene, Fl. Fran., 109. 1891.

Malvastrum orbiculatum Greene, Robinson in Gray, Synop. Fl. 1, pt. 1:313. 1897. Abrams. Fl. L. A., 229. 1917. Davidson & Moxley, Fl. So. Calif., 233. 1923. *Malvastrum Fremontii* var. *orbiculatum* (Greene) Johnston, Pl. World 22:109. 1919. *Malvastrum Fremontii* of Davidson, List Pls. L. A., Co., 3. 1892. Cat. Pls. L. A. Co., 5. 1896. Erythea 4:69. 1896; of Abrams, Fl. L. A., 248. 1904; of Robinson in Gray, Synop. Fl. 1, pt. 1:312. 1897 for "San Bernardino Co."; of Davidson & Moxley, Fl. So. Calif., 233. 1923. *Malvastrum Davidsonii* of Robinson in Gray, Synop. Fl. 1, pt. 1:312. 1897 for "Antelope Valley" and "Bear Valley"; of Parish, Pl. World 20:222. 1917. *Malacothamnus orbiculatus* Greene, Leaflets 1:208. 1906. Abrams, Bull. N. Y. Bot. Gard. 6:418. 1910. *Malveopsis Fremonti* of Davidson, Erythea 2:63. 1894.

Suffrutescent, the stout, erect, and simple branches 1-2 m. high, whole plant densely tomentose with stellate hairs; ultimate branches 2-4 mm. thick; upper leaves mostly 3-5 lobed, coarsely crenate, but often orbicular, blade 2.5-4 cm. long, base mostly sub-cordate, tip very obtuse, both surfaces rather densely tomentose with stellate hairs and with rather fine veins; flowers many, nearly sessile and densely glomerate in the axils of the upper leaves and at almost leafless subterminal nodes, however, sometimes borne on peduncles 2-8 cm. long; calyx 8-10 mm. long, segments 3-7 mm. long, 2-4 mm. wide, tip triangular to lanceolate, covered and almost obscured by very dense spreading stellate hairs or very scurfy with dense shorter hairs; bractlets 4-6 mm. long, lanceolate; corolla rose-color; petals 10-12 mm. long, asymmetrically obovate and slightly clawed; carpels 2mm. high; seeds flat to triangular, 1-1.5 mm. long, red-brown.

Dry slopes of the mountains bordering the Mohave Desert from the Tehachapi Mts. to the San Bernardino Mts.; apparently in the Upper Sonoran Zone. Type locality, Tehachapi Mts., Kern County. Ventura Co.: Mt. Frazier, *Elmer* 3895 (Po, UC). Los Angeles Co.: Swartout Valley, San Antonio Mts., *Munz* 7723 (Po); Prairie Fork of San Gabriel River, *Johnston* 1673 (Po, UC); Mint Canyon, *Peirson* 2672 (Po, FP); Rock Creek, San Gabriel Mts., *Peirson* 502 (FP); Oak Grove Canyon, Liebre Mts., *Abrams & McGregor* 405 (Po). San Bernardino Co.: Johnson's Grade, San Bernardino Mts., *Peirson* 5153 (FP) and *Johnston in* 1924 (Po); Little Rock, *Peirson* 68 (FP); north side of San Bernardino Mts., *Parish in* 1886 (UC).

A NEW MALVASTRUM, CALIFORNIA

PHILIP A. MUNZ*

In connection with the preparation of the paper on Southern California Malvastrums by Mr. Estes, considerable material from outside Southern California was studied. Three collections from San Luis Obispo County or Monterey County were seen which do not seem to belong to any described species so far as I can learn. I take pleasure in dedicating this new species to Professor Marcus E. Jones, whose extensive collecting in California, as well as other parts of the West, merits such recognition.

Malvastrum Jonesii n. sp.

Shrub, apparently erectly branched; branches rather slender and numerous, with short dense soft stellate-tomentum, ultimate branches 1.5-3 mm. thick; leaves rather close, firm, longer than internodes; petioles 1-2 cm. long, soft stellate-pubescent; blades suborbicular, obscurely 3- to 5-lobed, coarsely and irregularly crenate-dentate, closely velvety pubescent above and below, pale green, not rugose, scarcely bicolored, 1.0-2.5 cm. long, equally wide; apex obtuse, rounded; base scarcely, if at all cordate; stipules subulate, 4-5 mm. long, early deciduous; flowers solitary or 2 to several in upper axils; pedicels 2-7 mm. long; bractlets subulate, 3-4 mm. long, shorter than calyx, densely stellate-pubescent; calyx 8-9 mm. high, loosely stellate-tomentose without, more simply tomentose within; calyx-lobes triangular ovate, ca. 5 mm. long, 3-3.5 mm. broad, acute, enervous; petals apparently pink, 12-14 mm. long, 11-15 mm. wide, oblique-asymmetrical, subsessile, rounded above, styles 6-7 mm. long; style-lobes minutely pubescent, slightly thickened at summit, 3-4 mm. long, ca. 12; stamens ca. 50, quite glabrous; connective not prolonged; ovary glabrous; mature fruit not seen.

San Luis Obispo Co.: Paso Robles, *M. E. Jones* 223, June 26, 1902, (Type, Pomona College Herbarium, No. 60429). San Luis Obispo Co? or Monterey Co?: Santa Lucia Mts., *Barber in* 1901 (Po); Santa Lucia Mts. above Nascimiento River, *Brewer* 554 (UC).

In the tomentose pubescence of the triangular-ovate calyx-lobes, in the rounded leaves and short bractlets, the proposed species suggests *M. Fremontii*, *M. Davidsonii*, and *M. orbiculatum*. But the combination of characters of uniformly small leaves with very soft velvety pubescence, the slender branches and less conspicuously tomentose calyx set it quite apart.

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New species and varieties listed in bold face.

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